Y 4. G 74/7: AE 8/3

National Aeronautics and Space Admi...

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION: MAJOR MANAGEMENT ISSUES

HEARING

BEFORE THE

LEGISLATION AND NATIONAL SECURITY SUBCOMMITTEE

OF THE

COMMITTEE ON GOVERNMENT OPERATIONS HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

OCTOBER 6, 1993

Printed for the use of the Committee on Government Operations

...VERNMENT OF DOCUMENTS
...DEPOSITORY
FEB 4 1994
...STON PUBLIC LIBRARY
...COMMUNICATIONS DEPARTMENT

U.S. GOVERNMENT PRINTING OFFICE

74-136 CC WASHINGTON : 1993

For sale by the U.S. Government Printing Office
Superintendent of Documents, Congressional Sales Office, Washington, DC 20402
ISBN 0-16-043292-8

103

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION: MAJOR MANAGEMENT ISSUES

Y 4.G 74/7:AE 8/3

National Aeronautics and Space Admi...

HEARING

BEFORE THE

LEGISLATION AND NATIONAL SECURITY SUBCOMMITTEE

OF THE

COMMITTEE ON GOVERNMENT OPERATIONS HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

OCTOBER 6, 1993

Printed for the use of the Committee on Government Operations

DEPOSITORY

FEB 4 1994

BOSTON PUBLIC LIBRARY

U.S. GOVERNMENT PRINTING OFFICE

74-136 CC WASHINGTON : 1993

For sale by the U.S. Government Printing Office
Superintendent of Documents, Congressional Sales Office, Washington, DC 20402
ISBN 0-16-043292-8

COMMITTEE ON GOVERNMENT OPERATIONS

JOHN CONYERS, JR., Michigan, *Chairman*

CARDISS COLLINS, Illinois
GLENN ENGLISH, Oklahoma
HENRY A. WAXMAN, California
MIKE SYNAR, Oklahoma
STEPHEN L. NEAL, North Carolina
TOM LANTOS, California
MAJOR R. OWENS, New York
EDOLPHUS TOWNS, New York
JOHN M. SPRATT, JR., South Carolina
GARY A. CONDIT, California
COLLIN C. PETERSON, Minnesota
KAREN L. THURMAN, Florida
BOBBY L. RUSH, Illinois
CAROLYN B. MALONEY, New York
THOMAS M. BARRETT, Wisconsin
DONALD M. PAYNE, New Jersey
FLOYD H. FLAKE, New York
JAMES A. HAYES, Louisiana
CRAIG A. WASHINGTON, Texas
BARBARA-ROSE COLLINS, Michigan
CORRINE BROWN, Florida
MARJORIE MARGOLIES-MEZVINSKY, Pennsylvania
LYNN C. WOOLSEY, California
GENE GREEN, Texas
BART STUPAK, Michigan

WILLIAM F. CLINGER, JR., Pennsylvania
AL McCANDLESS, California
J. DENNIS HASTERT, Illinois
JON L. KYL, Arizona
CHRISTOPHER SHAYS, Connecticut
STEVEN SCHIFF, New Mexico
C. CHRISTOPHER COX, California
CRAIG THOMAS, Wyoming
ILEANA ROS-LEHTINEN, Florida
DICK ZIMMER, New Jersey
WILLIAM H. ZELIFF, JR., New Hampshire
JOHN M. McHUGH, New York
STEPHEN HORN, California
DEBORAH PRYCE, Ohio
JOHN L. MICA, Florida
ROB PORTMAN, Ohio

BERNARD SANDERS, Vermont
(Independent)

JULIAN EPSTEIN, *Staff Director*
MATTHEW R. FLETCHER, *Minority Staff Director*

LEGISLATION AND NATIONAL SECURITY SUBCOMMITTEE

JOHN CONYERS, JR., Michigan, *Chairman*

CARDISS COLLINS, Illinois
GLENN ENGLISH, Oklahoma
STEPHEN L. NEAL, North Carolina
CAROLYN B. MALONEY, New York
TOM LANTOS, California
CORRINE BROWN, Florida

AL McCANDLESS, California
WILLIAM F. CLINGER, JR., Pennsylvania
JON L. KYL, Arizona
DICK ZIMMER, New Jersey

JAMES C. TURNER, *Staff Director*
JOSEPH CIRINCIONE, *Deputy Staff Director*
MIRANDA G. KATSOYANNIS, *Professional Staff Member*
CHERYL A. PHELPS, *Professional Staff Member*
ERIC M. THORSON, *Professional Staff Member*
BENNIE B. WILLIAMS, *Clerk*
CHERYL G. MATCHO, *Clerk*
ROSALIND BURKE-ALEXANDER, *Clerk*
STEPHAN L. VINCZE, *Minority Professional Staff*
ELLEN BROWN, *Minority Procurement Counsel*

CONTENTS

Page

Hearing held on October 6, 1993 1

Statement of:

Colvin, Bill D., inspector general, National Aeronautics and Space Administration 39

Conahan, Frank, Assistant Comptroller General, National Security and International Affairs Division, U.S. General Accounting Office 11

Conyers, Hon. John, Jr., a Representative in Congress from the State of Michigan, and chairman, Legislation and National Security Subcommittee: Opening statement 1

Dailey, John R., Acting Deputy Administrator, National Aeronautics and Space Administration, accompanied by Deidre A. Lee, Associate Administrator for Procurement; Benita A. Cooper, Associate Administrator for Management Systems and Facilities; and Malcolm L. Peterson, Acting Comptroller 65

McCurdy, Howard E., professor of public affairs, American University 113

Pike, John E., director, space policy project, Federation of American Scientists 77

Smith, Marcia S., Specialist, Science Policy Research Division, Congressional Research Service, Library of Congress, accompanied by David P. Radzanowski, analyst 136

Letters, statements, etc., submitted for the record:

Clinger, Hon. William F., Jr., a Representative in Congress from the State of Pennsylvania: Prepared statement 8

Colvin, Bill D., inspector general, National Aeronautics and Space Administration: Prepared statement 44

Conahan, Frank, Assistant Comptroller General, National Security and International Affairs Division, U.S. General Accounting Office:

Information regarding reported value of NASA personal property as of September 30, 1992 59

Prepared statement 14

Conyers, Hon. John, Jr., a Representative in Congress from the State of Michigan, and chairman, Legislation and National Security Subcommittee: Opening statement 3

Dailey, John R., Acting Deputy Administrator, National Aeronautics and Space Administration:

Information regarding audits and investigations requested by NASA . 65

Prepared statement 68

McCandless, Hon. Al, a Representative in Congress from the State of California: Prepared statement 9

McCurdy, Howard E., professor of public affairs, American University: Prepared statement 115

Pike, John E., director, space policy project, Federation of American Scientists: Prepared statement 79

Smith, Marcia S., Specialist, Science Policy Research Division, Congressional Research Service, Library of Congress: Prepared statement 137

APPENDIX

Material submitted for the hearing record 155

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION: MAJOR MANAGEMENT ISSUES

WEDNESDAY, OCTOBER 6, 1993

HOUSE OF REPRESENTATIVES,
LEGISLATION AND NATIONAL SECURITY SUBCOMMITTEE
OF THE COMMITTEE ON GOVERNMENT OPERATIONS,
Washington, DC.

The subcommittee met, pursuant to notice, at 10:15 a.m., in room 2154, Rayburn House Office Building, Hon. John Conyers, Jr. (chairman of the subcommittee) presiding.

Members present: Representatives John Conyers, Jr., Carolyn B. Maloney, Al McCandless, William F. Clinger, Jr., and Dick Zimmer.

Subcommittee staff present: James C. Turner, staff director; Joseph Cirincione, deputy staff director; Bennie B. Williams, clerk; Stephan L. Vincze, minority professional staff; and Ellen Brown, minority procurement counsel.

OPENING STATEMENT OF CHAIRMAN CONYERS

Mr. CONYERS. The Legislation and National Security Subcommittee will come to order.

Good morning, committee witnesses and ladies and gentlemen. We have called this hearing to examine the National Aeronautics and Space Administration management problems, particularly in the wake of the Mars Observer probe, the Hubble space telescope, and certain space station problems. There have been programmatic failures, nobody will disagree. The size of these program failures run to $1.5 billion at least in terms of Hubble, $1 billion missing in the Mars Observer operation, the failure of a key weather satellite shortly after launch, and of course the ever-redesigned space station itself.

Cumulatively, this raises a number of particular questions to the oversight committee of the Congress. When individual projects are as costly and complex as those involved in space exploration, the job of restructuring NASA must include a careful review of the major failures and their implications for new proposed projects. In the stringent economic times that exist, we can demand no less.

This is not an accusatory hearing, this is not about finger pointing, but it is about a wide-eyed examination of a part of our government that consumes billions of dollars annually. So what we need to do, thanks to our first witnesses, is to examine this, and we are grateful to you, Mr. Conahan, Mr. Colvin, and others of your organization for joining us today.

GAO, in particular, has a long continuing relationship with us on this subject. The inspector general, Mr. Colvin, is to be commended for the difficult job that is first of all an inspector general's responsability in a circumstance like this.

[The opening statement of Mr. Conyers follows:]

OPENING STATEMENT

BY

CHAIRMAN JOHN CONYERS, JR.

COMMITTEE ON GOVERNMENT OPERATIONS

LEGISLATION AND NATIONAL SECURITY SUBCOMMITTEE

AN OVERSIGHT HEARING ON

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION:

MAJOR MANAGEMENT ISSUES

WEDNESDAY, OCTOBER 6, 1993

THE LEGISLATION AND NATIONAL SECURITY SUBCOMMITTEE WILL COME TO ORDER.

THIS HEARING WILL EXAMINE THE MAJOR MANAGEMENT ISSUES CONFRONTING THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION.

AFTER YEARS OF SPECTACULAR SUCCESS, NASA HAS EXPERIENCED A SERIES OF SPECTACULAR FAILURES. EVERYONE AGREES WE HAVE SOME FORMIDABLE MANAGEMENT PROBLEMS AT THE AGENCY.

THE GENERAL ACCOUNTING OFFICE IDENTIFIED NASA CONTRACT MANAGEMENT AS ONE OF 17 "HIGH-RISK" FEDERAL PROGRAM AREAS. THE GAO FOUND THAT:

- NASA HAS A $20 BILLION FUNDING GAP BETWEEN ITS PLANS AND ITS EXPECTED BUDGETS OVER THE NEXT FIVE YEARS.
- NASA'S MAJOR PROGRAMS CONTINUE TO INCREASE IN COST AND DECREASE IN PERFORMANCE. HALF OF NASA'S PROGRAMS HAVE INCREASED BY 77 PERCENT OR MORE.
- INADEQUATE NASA OVERSIGHT LETS CONTRACTORS CHARGE UNALLOWABLE COSTS TO THE GOVERNMENT -- INCLUDING EXPENSES FOR LOBBYING THE GOVERNMENT.
- NASA'S BOOKS ARE TOO UNRELIABLE TO AUDIT, YET NASA STILL HAS NOT APPOINTED A CHIEF FINANCIAL OFFICER AS REQUIRED BY LAW.

THE NASA INSPECTOR GENERAL HAS UNCOVERED SERIOUS PROCUREMENT FRAUD AND ABUSE, INCLUDING:

- PRICE-GOUGING BY COMPANIES MAKING UP TO 288 PERCENT PROFIT ON NASA CONTRACTS;
- MILLIONS OF DOLLARS IN AWARD FEES PAID TO CONTRACTORS

WHO DON'T DESERVE THEM;

- NASA WORKERS LITERALLY ASLEEP ON THE JOB, WITH ALMOST HALF THE WORKERS ON SOME SHIFTS NOT DOING ANY WORK AT ALL; AND,
- FRAUDULENT CERTIFICATION OF CRITICAL TRANSISTORS AND OTHER ELECTRONIC PARTS THAT COULD RESULT IN "LOSS OF MISSION AND LIFE." THE IG FOUND LITTLE ASSURANCE THAT THESE PARTS WOULD PERFORM AS DESIGNED. SUCH FAILURES ARE BELIEVED TO BE RESPONSIBLE FOR THE LOSS OF THE MARS OBSERVER PROBE AND A NEW WEATHER SATELLITE.

IT IS NO WONDER THAT MANY PEOPLE SEEM TO HAVE LOST FAITH IN NASA. A RECENT GALLUP POLL SHOWED THAT A MAJORITY OF AMERICANS NOW BELIEVE THE SPACE BUDGET SHOULD BE CUT. AND ONLY 43 PERCENT OF THE PUBLIC BELIEVE THAT NASA IS PERFORMING WELL -- A SHARP DROP FROM THE 64 PERCENT SUPPORTING NASA JUST TWO YEARS AGO.

THE GOOD NEWS IS THAT NASA ACKNOWLEDGES THAT ITS CONTRACT MANAGEMENT IS VULNERABLE TO WASTE AND ABUSE. IN FACT, ITS HARSHEST CRITIC MAY BE NASA ADMINISTRATOR DAN GOLDIN. HE HAS VOWED TO SHAKE UP THE AGENCY.

MR. GOLDIN COULD NOT APPEAR BEFORE THE SUBCOMMITTEE TODAY. HE IS IN RUSSIA NEGOTIATING THE RUSSIAN ROLE IN THE PROPOSED SPACE STATION. NASA IS REPRESENTED, HOWEVER, BY THE OFFICIALS DIRECTLY RESPONSIBLE FOR OVERSEEING THE ALMOST $13 BILLION NASA SPENDS EACH YEAR ON PROCUREMENT.

WE ALSO HAVE A PANEL OF EXPERT WITNESSES TO HELP ASSESS THE PROSPECTS FOR SUCCESSFULLY REFORMING NASA.

THE HEARING WILL REVIEW HOW THE RECOMMENDATIONS TO IMPROVE NASA MANAGEMENT MADE BY THE GAO, THE INSPECTOR GENERAL AND BY THE NASA ADMINISTRATOR ARE BEING IMPLEMENTED.

WE HAVE WORKED CLOSELY WITH THE MINORITY IN PREPARATION FOR THIS HEARING, AND I NOW TURN TO THEIR DISTINGUISHED LEADER, THE GENTLEMAN FROM CALIFORNIA, FOR ANY REMARKS HE MAY HAVE.

Mr. CONYERS. Let me now ask Mr. Bill Clinger if he has any opening comments before we begin.

Mr. CLINGER. Thank you very much, Mr. Chairman. I join my colleagues in welcoming this opportunity to review the major management issues which currently affect NASA. Clearly, as many experts have pointed out, NASA must adapt to a new era and change its management practices to cut costs and eliminate waste. Indeed our entire government must do so, and that will be a focus of this committee's attention for some months and perhaps years to come.

This hearing should prove to be a constructive step toward insuring NASA is on the right path toward completing the management reforms necessary to meet its mission in a cost-effective manner without sacrificing quality scientific advancements.

I wish to caution my fellow members, however, that it is important that we keep a healthy perspective on NASA. As we seek to correct NASA's mistakes, we should not lose sight of its many successes. I think all of us would agree that in the 35 years since its inception, NASA has improved our world through a better understanding of the world beyond. The challenge facing us now, however, appears to be twofold: First, what priorities do we as a Nation want NASA to focus on, and, second, how do we want NASA to meet these new priorities when we have a world of shrinking budgets and increasing fiscal austerity.

While NASA has clearly experienced tragic and costly failures, we must remember that as Benjamin Disraeli stated over 100 years ago, "[t]he secret of success is constancy to purpose." Neither Columbus nor the Wright brothers would have succeeded had they not persisted after encountering failures. So while we certainly should continue to reexamine NASA's management and seek improvement, we should not abandon our resolve to "push the envelope" and to continue to explore the frontier of space.

Throughout history, mankind has benefited from its persistent pursuit of understanding the unknown. Let us not at this historical juncture succumb to short-term fears and concerns. Rather, I would hope that we would rise to the challenge, as Americans have historically done, and apply our resolve to balancing our appropriate immediate fiscal concerns, which are very real, with our continued long-term interest in solving the mysteries of space.

So I look forward to hearing from our distinguished witnesses and their views on how NASA is doing to meet these difficult challenges. Mr. Chairman, I would ask unanimous consent that a statement by Mr. McCandless, the ranking member on the subcommittee, be entered in the record at this point.

Mr. CONYERS. Without objection, so ordered. We thank your for your profound opening remarks.

[The prepared statements of Mr. Clinger and Mr. McCandless follow:]

JOHN CONYERS, JR., MICHIGAN
CHAIRMAN

CARDISS COLLINS, ILLINOIS
GLENN ENGLISH, OKLAHOMA
HENRY A. WAXMAN, CALIFORNIA
MIKE SYNAR, OKLAHOMA
STEPHEN L. NEAL, NORTH CAROLINA
TOM LANTOS, CALIFORNIA
MAJOR R. OWENS, NEW YORK
EDOLPHUS TOWNS, NEW YORK
JOHN M. SPRATT, JR., SOUTH CAROLINA
GARY A. CONDIT, CALIFORNIA
COLLIN C. PETERSON, MINNESOTA
KAREN L. THURMAN, FLORIDA
BOBBY L. RUSH, ILLINOIS
CAROLYN B. MALONEY, NEW YORK
THOMAS M. BARRETT, WISCONSIN
DONALD M. PAYNE, NEW JERSEY
FLOYD H. FLAKE, NEW YORK
JAMES A. HAYES, LOUISIANA
CRAIG A. WASHINGTON, TEXAS
BARBARA-ROSE COLLINS, MICHIGAN
CORRINE BROWN, FLORIDA
MARJORIE MARGOLIES-MEZVINSKY, PENNSYLVANIA
LYNN C. WOOLSEY, CALIFORNIA
GENE GREEN, TEXAS
BART STUPAK, MICHIGAN

ONE HUNDRED THIRD CONGRESS

Congress of the United States

House of Representatives

COMMITTEE ON GOVERNMENT OPERATIONS

2157 RAYBURN HOUSE OFFICE BUILDING

WASHINGTON, DC 20515-6143

WILLIAM F. CLINGER, JR., PENNSYLVANIA
RANKING MINORITY MEMBER
AL McCANDLESS, CALIFORNIA
J. DENNIS HASTERT, ILLINOIS
JON L. KYL, ARIZONA
CHRISTOPHER SHAYS, CONNECTICUT
STEVEN SCHIFF, NEW MEXICO
C. CHRISTOPHER COX, CALIFORNIA
CRAIG THOMAS, WYOMING
ILEANA ROS-LEHTINEN, FLORIDA
RONALD K. MACHTLEY, RHODE ISLAND
DICK ZIMMER, NEW JERSEY
WILLIAM H. ZELIFF, JR., NEW HAMPSHIRE
JOHN M. McHUGH, NEW YORK
STEPHEN HORN, CALIFORNIA
DEBORAH PRYCE, OHIO
JOHN L. MICA, FLORIDA
ROB PORTMAN, OHIO

BERNARD SANDERS, VERMONT
INDEPENDENT

MAJORITY—(202) 225-5051
MINORITY—(202) 225-5074

Opening Statement
of the Honorable William F. Clinger, Jr.
Subcommittee on Legislation and National Security
Government Operations Committee
October 6, 1993

Thank you, Mr. Chairman. I join my distinguished colleagues in welcoming this opportunity to review the major management issues currently affecting the National Aeronautics and Space Administration (NASA). Clearly, as many experts have pointed out, NASA must adapt to a new era and change its management practices to cut costs and eliminate waste -- indeed, our entire government must do so. This hearing should prove to be a constructive step towards ensuring that NASA is on the right path towards completing the management reforms necessary to meet its mission in a cost-effective manner without sacrificing quality scientific advancements.

I too, however, wish to caution my fellow Members that it is important that we keep a healthy perspective on NASA. As we seek to correct NASA's mistakes, we should not lose sight of its many successes. I think all of us would agree that in the thirty-five years since its inception, NASA has improved our world through a better understanding of the world beyond.

The challenge facing us now, however, appears to be twofold: first, what priorities do we as a nation want NASA to focus on, and second, how do we want NASA to meet these new priorities in an era of shrinking budgets and fiscal austerity. While NASA has clearly experienced tragic and costly failures, we must remember that, as Benjamin Disraeli so aptly stated over a hundred years ago, "The secret of success is constancy to purpose." Neither Columbus nor the Wright Brothers would have succeeded had they not persisted after encountering failure. So while we certainly should continue to re-examine NASA's management and seek improvement, we should not abandon our resolve to "push the envelope" and to explore the frontier of space. Throughout history, mankind has benefitted from its persistent pursuit of understanding the unknown. Let us not at this historical juncture succumb to short-term fears and concerns. Rather, let us rise to the challenge, as Americans historically have done, and apply our resolve to balancing our appropriate immediate fiscal concerns with our continued long-term interest in solving the mysteries of space.

I look forward to hearing from our distinguished witnesses and their views on how NASA is doing to meet these difficult challenges.

JOHN CONYERS, JR., MICHIGAN
CHAIRMAN
CARDISS COLLINS, ILLINOIS
GLENN ENGLISH, OKLAHOMA
HENRY A. WAXMAN, CALIFORNIA
MIKE SYNAR, OKLAHOMA
STEPHEN L. NEAL, NORTH CAROLINA
TOM LANTOS, CALIFORNIA
MAJOR R. OWENS, NEW YORK
EDOLPHUS TOWNS, NEW YORK
JOHN M. SPRATT, JR., SOUTH CAROLINA
GARY A. CONDIT, CALIFORNIA
COLLIN C. PETERSON, MINNESOTA
KAREN L. THURMAN, FLORIDA
BOBBY L. RUSH, ILLINOIS
CAROLYN B. MALONEY, NEW YORK
THOMAS M. BARRETT, WISCONSIN
DONALD M. PAYNE, NEW JERSEY
FLOYD H. FLAKE, NEW YORK
JAMES A. HAYES, LOUISIANA
CRAIG A. WASHINGTON, TEXAS
BARBARA-ROSE COLLINS, MICHIGAN
CORRINE BROWN, FLORIDA
MARJORIE MARGOLIES-MEZVINSKY, PENNSYLVANIA
LYNN C. WOOLSEY, CALIFORNIA
GENE GREEN, TEXAS
BART STUPAK, MICHIGAN

ONE HUNDRED THIRD CONGRESS

Congress of the United States
House of Representatives
COMMITTEE ON GOVERNMENT OPERATIONS
2157 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515–6143

WILLIAM F. CLINGER, JR., PENNSYLVANIA
RANKING MINORITY MEMBER
AL MCCANDLESS, CALIFORNIA
J. DENNIS HASTERT, ILLINOIS
JON L. KYL, ARIZONA
CHRISTOPHER SHAYS, CONNECTICUT
STEVEN SCHIFF, NEW MEXICO
C. CHRISTOPHER COX, CALIFORNIA
CRAIG THOMAS, WYOMING
ILEANA ROS-LEHTINEN, FLORIDA
RONALD K. MACHTLEY, RHODE ISLAND
DICK ZIMMER, NEW JERSEY
WILLIAM H. ZELIFF, JR., NEW HAMPSHIRE
JOHN M. MCHUGH, NEW YORK
STEPHEN HORN, CALIFORNIA
DEBORAH PRYCE, OHIO
JOHN L. MICA, FLORIDA
ROB PORTMAN, OHIO

BERNARD SANDERS, VERMONT
INDEPENDENT

MAJORITY—(202) 225-5051
MINORITY—(202) 225-5074

Opening Statement
of the Honorable Al McCandless
October 6, 1993

Thank you, Mr. Chairman. Since the creation of the National Aeronautics and Space Administration (NASA) in 1958, Americans and the world have marveled at the spectacular technological achievements accomplished by NASA's scientific pioneers. From the historic moon landing to the amazing advancements in satellite communications and observation systems, NASA has helped America and the world to learn about space and to apply this understanding to improve all of our lives.

History has taught us, however, that pioneering efforts whether here on earth or in space are inherently high-risk and dangerous endeavors. The Apollo tragedy in 1967 that killed three astronauts, and, of course, the Challenger disaster in 1986 that killed seven astronauts clearly illustrate this sobering fact of life. These terrible accidents and other recent failures have raised appropriate questions about the management of NASA and its programs. Since 1986, at least a half a dozen reports and Commissions have reviewed the internal management of NASA and the future of the Space program. Today, our subcommittee joins the four other principal committee's in the House and Senate that oversee NASA. While I join the Chairman in welcoming this responsibility, I caution all of us that it may be time to let NASA make the management changes recommended by all of these earlier commissions and reports. Nevertheless, I look forward to playing a constructive role in helping NASA adapt to a changed world.

The world and our own domestic situation have indeed changed dramatically since 1958 when NASA was first created. What a change from the intense competition and race to the moon between the Soviet Union and the United States during the Cold War to current proposals for a joint American and Russian space station; and what a change from the economic growth in the 60's and 80's to our current economic priorities of controlling federal spending and cutting the federal deficit! It is abundantly clear that NASA and other federal agencies can not continue to do business as they had before. We all need to tighten our belts and to find ways of doing more with less.

Accordingly, I am gratified to see that NASA currently has as its Acting Deputy Director a gentleman who, as a former Assistant Commandant of the Marine Corps, certainly should understand what it means to do more with less. As a former Marine, I know that Marines pride themselves as a lean, efficient, and can-do group. This approach and attitude may be precisely what NASA and other federal agencies need to effectively meet current and future challenges. I look forward to hearing from General Dailey and our other distinguished witnesses today as we join together in what I trust will be a constructive oversight relationship.

Mr. CONYERS. Could I ask Mrs. Carolyn Maloney if she has any opening comments.

Mrs. MALONEY. First of all, I would like to thank you, Mr. Chairman, for calling this hearing. We are all familiar with the many successes of NASA, but many of us are troubled that NASA's major programs continue to increase in cost but decrease in performance. Many of us were very concerned about the space station, and it was hotly debated. It was an amendment that Mr. Zimmer and I brought to the floor, along with Mr. Roemer. That was an example of the problems that NASA has been having, and I am glad that we are having this oversight hearing.

Mr. CONYERS. Mr. Zimmer.

Mr. ZIMMER. Thank you, Mr. Chairman.

As a member of the Space Subcommittee, I am delighted to participate in this hearing. It is clear to me that NASA has had chronic management problems since we first landed on the Moon. An unclear mission, contradictory mandates from Congress, and unstable funding have exacerbated the problems, and I believe that this space station which Mrs. Maloney referred to is a prime example of the management difficulties NASA has had in bringing a complicated program from concept to reality.

NASA has spent 8 years and $10 or $11 billion planning and designing the space station. Recently, we have taken so many steps backward that at present we don't even have a design for the overall space station, let alone the individual components. The space station has in many ways been a victim of politics. Constantly changing mandates and budgets from Congress have made the program more difficult to manage.

Space Station Freedom was perhaps the first space station ever designed in a congressional subcommittee, and that may be one reason that it has had so much difficulty. However, NASA itself has repeatedly promised more than could be delivered under the best of circumstances.

Unrealistically optimistic assessments of cost and schedules for the project resulted in high expectations in Congress and among taxpayers. The repeated announcements of cost overruns, slipped schedules, and reduced capability returned the project again and again to the political arena. I believe that better and more accurate assessments of real project cost schedules and capabilities are essential if NASA is to improve its current poor track record and to achieve some credibility with the public and with Congress.

I also believe that in order to make NASA more accountable, more extensive use ought to be made of independent expert review panels, like the Vest Committee that reviewed the initial redesign options for the space station program. The Vest panel—chaired by the president of MIT—gave a comprehensive, objective, and lucid assessment of each option, but what is now being called Space Station Alpha is not what the Vest Committee has reviewed.

NASA is a natural advocate of the space station in any of its iterations because it is a NASA program. In contrast, the Vest Committee's detachment from the program made its assessment possibly the most valuable ever provided for the space station program. Accordingly, I am going to be discussing during this hearing and I am going to be proposing in legislative form this week a re-

quirement that NASA submit its new design of Space Station Alpha to the Vest Committee for complete review and validation.

Thank you very much, Mr. Chairman.

Mr. CONYERS. Thank you very much, Mr. Zimmer.

Just for clarification for the record, when you referred to the space station's trouble perhaps having originated from being designed in a congressional subcommittee, you were not referring to this subcommittee, I assume?

Mr. ZIMMER. I was definitely not. Would you like me to tell you which one I was referring to?

Mr. CONYERS. Well, let me guess. It is another one on which you serve?

Mr. ZIMMER. No, as a matter of fact.

Mr. CONYERS. Well, which one?

Mr. ZIMMER. It was a subcommittee of the House Appropriations Committee.

Mr. CONYERS. Oh, I see. It was not the space Subcommittee of Science and Technology upon which you serve?

Mr. ZIMMER. No, it was not.

Mr. CONYERS. I am relieved to know that.

Mr. Conahan, we welcome you again. Across the years, you and we have become very close, and you pointed out that NASA contract management is one of the 17 high risk Federal program areas, and that is a serious statement; that NASA has a $20 billion funding gap between its plans and expected budgets over the next 5 years; that their major programs continue to increase in cost and decrease in performance; that half of their programs have increased by 77 percent or more; that inadequate oversight in NASA has allowed contractors to charge unallowable costs to the government, including lobbying expenses; finally, that NASA's books are in a state of disrepair that preclude audit, and yet they have neglected to appoint a chief financial officer, a law that originated in this committee as is required under the Federal laws. So, we welcome you, and we will accept your written statement, and all other prepared statements of witnesses, without objection to be reproduced in their entirety and ask you to proceed in your own way.

STATEMENT OF FRANK CONAHAN, ASSISTANT COMPTROLLER GENERAL, NATIONAL SECURITY AND INTERNATIONAL AFFAIRS DIVISION, U.S. GENERAL ACCOUNTING OFFICE

Mr. CONAHAN. Thank you, Mr. Chairman, members of the subcommittee. I want to thank you for the invitation to be here this morning. You, I think, gave a very good summary of my prepared statement, and perhaps rather than repeating much of what you have said, I could perhaps just highlight some of the aspects of the things that I was going to say this morning.

You are very familiar with the transition series of reports that the General Accounting Office issued in December of last year, one of which covered NASA issues. In that report, we said that there were major challenges confronting NASA. They were bringing plans in line with likely budgets, you mentioned that; managing systems development efforts more efficiently, that was mentioned; improving operations and oversight; and preserving the U.S. aeronautical leadership.

In connection with bringing plans in line with likely budgets, Mr. Chairman, I would like to point out that for some time we have been urging NASA to develop a strategic plan that realistically matches its program plans with likely budgetary resources that will be made available to the agency.

It is kind of interesting. In August 1991, I appeared before the Space, Science and Technology Committee and talked about the efforts underway in NASA at that time to develop a strategic plan. I said then that it was awaiting approval by the NASA Administrator.

Well, I am here to tell you today that that plan did not fly and that we don't even have a plan awaiting approval by the NASA Administrator. There is a plan under development, but that is as far as it goes. I think that the absence of that long-range plan does result in the kind of back and forth that takes place between the agency and the Congress.

We heard comments about the space station. That is not the only program that has been fitful in its development over the years. Other programs include the advanced x-ray astrophysics facility which was restructured, the Earth observing system—I might say in that regard that almost before that program got off the ground the Congress directed that the program be reduced from a $16 billion program to an $11 billion program through 2000. When NASA got finished with the design at that level, there were shortcomings in the program. The Congress has more recently directed them to reduce that program down to about $8 billion through 2000. We have rendered numerous reports on the national aerospace plane showing similar problems there. The corrective action would, in my view, be in NASA's coming up with a strategic plan that the Congress and the United States could buy into so that both the legislative and executive could go down this road together. That hasn't happened. Hopefully, we will see that under the current administration.

With respect to managing systems development more efficiently, you mentioned the significant cost growth and schedule slippage there and performance coming in under what was expected. I don't need to say much more about that. The current NASA Administrator has said that he is going to try and correct those problems. We will continue to monitor those actions.

You have pointed out that after 3 years or so this agency still does not have a chief financial officer. We, like you, believe that that is an order of very, very high priority, and I think we should discuss that further today.

Beyond that, there are problems with respect to procurement policies and procedures, and contracting activities. Indeed, NASA contract management is one of the 17 areas that we have selected as being vulnerable to waste, fraud, and abuse. In NASA, we also see problems with property furnished to contractors in terms of accountability and control. We can talk about that.

Then there are a host of other areas in testing, environmental protection, and facilities management and maintenance where I think improvements are required.

In conclusion, Mr. Chairman, just let me say that most of these problems are well known to the agency in varying degrees and that

the agency has from time to time confronted some of these problems, but not in the way that we think they should have. I think that we have to recognize that some of these problems have been in the making for a long time, and they are embedded in the culture of the organization. So in addition to the need to develop new and improved management systems, we have to see strong leadership and we have to see that leadership devolve its vision for the future into the very innards of this organization.

It is a decentralized organization. It has not had strong centralized control for a long period of time, and I think if we are going to see real improvements in this organization, we have to turn that culture around.

I think that is all I need to say, Mr. Chairman.

Mr. CONYERS. Thank you for a concise statement.

[The prepared statement of Mr. Conahan follows:]

United States General Accounting Office

GAO

Testimony

Before the Legislation and National Security Subcommittee, Committee on Government Operations, House of Representatives

For Release on Delivery
Expected at
10:00 a.m.,
EDT
Wednesday,
Oct. 6, 1993

NASA

Major Challenges for Management

Statement of Frank C. Conahan, Assistant Comptroller General, National Security and International Affairs Division

GAO/T-NSIAD-94-18

Mr. Chairman and Members of the Subcommittee:

I appreciate the opportunity to testify before the Subcommittee today on management challenges facing the National Aeronautics and Space Administration (NASA). On the basis of our work at NASA over the last 5 years, we believe the major problems confronting NASA today can be seen in terms of challenges to NASA management. Specifically, the agency faces challenges in:

-- bringing plans in line with likely budgets,

-- managing systems development efforts more efficiently,

-- improving operations and oversight, and

-- preserving U.S. aeronautical leadership.

We initially identified these management challenges in our December 1992 Transition Report on NASA Issues. The last 9 months have strengthened our view that they indeed represent the primary challenges the agency faces.

BRINGING PLANS IN LINE WITH LIKELY BUDGETS

Since the late 1980s, we have encouraged NASA to develop a strategic plan that realistically matches its program plans to its likely budgets. NASA's efforts to do so have been fitful at best, and no adequate plan has yet been prepared.

In 1991, the Senate Committee on Appropriations directed NASA to develop a strategic plan. Among other things, the plan was supposed to establish priorities for NASA's programs, especially in view of the likelihood of more modest budgets in the future. However, NASA's January 1992 plan--Vision 21--was not responsive to the Committee's direction. The plan failed to indicate the

relative priority of NASA's key missions and large programs and provided no balance between planning and budgeting.

Shortly after the plan was issued, we reported that this lack of balance was a serious concern because NASA, at that time, was planning budgets that called for up to about $20 billion more funding through fiscal year 1997 than the Congress was likely to provide. As shown on attachment I, this represents the difference between NASA's program plan for fiscal years 1992-1997 and level budgets of $14.3 billion which was the enacted NASA budget for fiscal year 1992. Consequently, NASA would be forced to make significant program adjustments each year to make up for lower-than-anticipated funding levels.

Some of NASA's largest programs have already required such adjustments. About a year ago we reported on 11 major programs in NASA which, at that time, had 5-year funding requirements that would account for most of the agency's likely budgets. (See attachment II.) A number of these--including space shuttle operations, the space station, the Advanced X-Ray Astrophysics Facility, the Earth Observing System, and the National Aero-Space Plane--have been or are currently being restructured, primarily because they were not affordable. I will discuss shuttle operating costs a little later in summarizing NASA's challenge to improve operations and oversight. The other programs are discussed briefly below to illustrate the effects of oversubscribed budgets.

Space Station

The space station provides the most telling illustration of problems in a program resulting from funding instability. The space station is currently undergoing its sixth redesign in 8 years. When we testified on the station in May 1991, we pointed out the instability that had surrounded the program, and we raised questions about the limited scope of NASA's cost estimate, the

station's utility as a research facility, and some of the future risks in the program. Since that time, the space station's situation has not improved. Its most recent redesign was ordered because the station was not affordable as then planned. Whether this latest attempt to design an affordable and useful space station is successful remains to be seen. We are just beginning to review the details of the new design, especially its cost estimate.

Advanced X-Ray Astrophysics Facility

The Advanced X-Ray Astrophysics Facility was also recently redesigned because of budget reductions and the need to control costs in future years. It was divided into two missions to be flown on separate satellites. One mission will be designed, developed, and built by a contractor to provide high-resolution x-ray imaging; the other will be done by NASA personnel to provide high-energy, high-resolution spectroscopy.

The restructuring of the astrophysics facility into two missions reduces the program's estimated development and operating costs by almost 60 percent--from $5.5 billion to $2.3 billion. The lower operating costs result primarily from flying the twin satellites for 5 rather than 15 years. This reduced operating time should not sacrifice much of the intended science because the necessary data can be gathered more efficiently at the new orbits planned for the twin satellites. However, these orbits increase the risk because the redesigned satellites cannot be reached by the shuttle, so they cannot be repaired if they malfunction. Such repair capability was intended under the previous single satellite design. We reported on the Advanced X-Ray Astrophysics Facility early last year, before it was split into two parts. We have since revisited the program and will be reporting on its status shortly.

Earth Observing System

The Earth Observing System is linked to U.S. and international efforts to study the Earth. It is intended to obtain space-based observations to improve scientists' understanding of the environment and to provide policymakers with some of the information they will need to develop sound environmental policy. In its short life, the Earth Observing System has been restructured twice because of questions about the long-term affordability of NASA's space research program.

The Earth Observing System program was barely underway when the Congress directed NASA to reduce its funding requirements from about $16 billion to $11 billion through fiscal year 2000. In response, NASA restructured the program in late 1991. The changes made included using a larger number of smaller satellites in lieu of a few large platforms and delaying the start of operations for most instruments by about 2 years. Even with these changes, achieving all of the restructured program's scientific objectives depended on NASA's ability to arrange development and flight opportunities for some planned instruments that were not accommodated by the program's new $11 billion funding profile.

In July 1992, we reported on the changes made to the program's scope, schedule, and estimated cost due to its restructuring. At that time NASA was still searching for ways to develop and fly some of the planned instruments it could not afford. However, shortly after our report was issued, the Congress directed NASA to restructure the program again--this time from an $11 billion to an $8 billion effort through fiscal year 2000. We expect to review the effects of this second restructuring when we next review the program later this year.

National Aero-Space Plane

The National Aero-Space Plane program has significant budget problems, but they are not solely NASA's problem because the program is jointly operated by the Department of Defense (DOD) and NASA. In fact, most of the program is DOD's responsibility. The program's goal is to provide the technological basis for future space launch and hypersonic flight vehicles. The concept involves developing a vehicle that can take off horizontally from a runway; reach hypersonic speeds of up to 25 times the speed of sound (Mach 25); attain low earth orbit without using external booster rockets or propellant tanks; and return for a runway landing.

Last year, we reported that the National Aero-Space Plane program's 7-year history has been characterized by turmoil, changes in focus, and unmet expectations. Projected costs were increasing, technical progress was behind schedule, and funds were insufficient to implement the program as planned. At the request of this and other subcommittees, we reported a few months ago on the status of efforts to resolve these problems. We noted that while the contractor team had made progress in resolving propulsion and weight-related problems, significant challenges remained. The contractor team reported earlier this year that 17 of the 38 milestones used to measure progress toward completing the program's development phase will not be fully satisfied by the end of 1994, the latest estimated development completion date. Consequently, the decision to design, test, and build the experimental flight vehicle has been deferred.

Our most recent report also noted that unstable funding and the lack of top-level direction had hindered efforts to develop an affordable, executable program. Neither the Office of Science and Technology Policy, the National Aero-Space Plane Steering Group, nor DOD had provided clear direction on what the program's future

efforts and objectives should be. Additionally, DOD and NASA had not achieved consensus on the current and future funding needs for the program. In late August, the Director of the Office of Science and Technology Policy told us that interagency working groups were being established to address the future of the National Aero-Space Plane and the funding requirements for a robust research program on hypersonic flight and advanced materials.

NASA's Corrective Actions

Vision 21, NASA's strategic plan, was developed before the current NASA Administrator was appointed. He has acknowledged the shortcomings of this plan and has promised a new NASA strategic plan that matches specific program goals with realistic budgets. That plan is still under development. In addition, the NASA Administrator said earlier this year that NASA's program reassessments have eliminated about half of the gap between its plans and likely budgets. We will be shortly following up on our original work to determine the extent the agency has been able to bring its plans in line with likely budgets.

MANAGING SYSTEMS DEVELOPMENT MORE EFFICIENTLY

Project management in NASA starts even before congressional new start authority is requested, when requirements are being developed and the initial components of cost and schedule estimates are being pulled together. Once a project is authorized, management of progress towards its cost, schedule, and performance goals involves the interaction of program, technical, and budget/accounting personnel until the project is completed or, on rare occasions, terminated. To effectively manage projects, NASA must establish realistic cost, schedule, and technical performance goals and then work to identify and mitigate problems that can significantly increase costs, disrupt schedules, and impair performance.

NASA projects often cost substantially more than initially estimated, frequently do not meet schedules, and sometimes perform at lower levels than originally forecast. Last year we reported on changes in cost estimates on 29 major NASA programs spanning the last 15 years. Cost estimates for about half of these programs increased by 77 percent or more. The average cost estimate increase would have been even higher except that the planned capability was reduced for a number of programs.

Reasons for the cost estimate changes included insufficient requirements determinations, budget constraints, project redesigns, overoptimistic cost and schedule goals, unanticipated technical complexity, incomplete initial cost estimates, and shuttle launch delays. We believe that NASA must be more willing to set priorities, identify and pursue cost-effective alternatives, and terminate low-priority projects when warranted. To do this effectively, NASA needs current, complete, and accurate information about projects, especially about their likely cost. All too often, NASA does not have this information. For many years, NASA has not paid adequate attention to costs, even though its world has changed. Today, NASA needs to deal with a more critical audience than the one it faced during the Cold War decades. The collapse of the Soviet Union, shortcomings in major NASA projects, the overall budget deficit, and needs in other federally funded areas, have combined to focus a critical eye on the agency. Learning to live with more restricted budgets, while at the same time, continuing to perform its science and engineering roles, will require NASA managers to elevate the importance of project cost and to better appreciate the full cost of the projects they design, develop, and operate.

The current NASA Administrator has acknowledged that successful program management requires an accurate understanding of the program's total resource requirements. We agree. Indeed, for at least the last 20 years we have pointed out that NASA's project

cost estimates have been incomplete, noting in report after report the elements that NASA routinely excluded from them. Recently, we repeated our concerns that the space station cost estimate was incomplete. In March of this year, program officials testified that the cost to achieve permanent human capability on the space station would be $31.3 billion. About 2 months later, a cost estimating team independent of the NASA space station program reported that a more realistic estimate was about $34 billion to $36 billion. In a report about the same time, we concluded that the cost estimate should be about $43 billion. Our estimate includes $7.6 billion in shuttle costs not included by NASA in its estimate.

Independent cost estimating has been the subject of a number of recommendations made to NASA in recent years. The need for NASA to have an independent cost estimating capability was addressed several years ago by an external review group--the Augustine Commission. The Commission recommended that NASA establish an independent cost analysis group to advise the Administrator on estimates provided to the Congress and the Office of Management and Budget. However, last year we reported that NASA's initial actions to establish such a group did not meet the intent of the recommendation because

-- results of formal cost reviews were not directly reported to the Administrator,

-- advice provided to the Administrator on cost estimates was informal and undocumented,

-- cost estimates were not reviewed at all major program milestones, and

-- the cost analysis group did not have adequate staff to perform independent estimates at all major milestones.

NASA's Corrective Actions

The Administrator responded to our work by announcing that he intended to establish a new independent cost assessment group with sufficient resources to carry out the functions envisioned by the Augustine Commission.

NASA's efforts to improve its cost estimating is only one of a series of recently announced program and project management reforms. These other reforms include improving NASA's understanding of a project's technical requirements at its inception, committing program managers to meeting those requirements within agreed cost and schedule goals, and providing early identification and resolution of development problems.

This last reform involves the use of the new Senior Program Management Council to provide Administrator-level attention to the progress, or the lack of progress, in a project's development. The Council process provides for a continuous review of programs and may ultimately lead to termination of a project. That possibility currently confronts the Advanced Solid Rocket Motor because of budgetary pressures and the absence of a firm, near-term requirement.

The Advanced Solid Rocket Motor was intended to enhance the space shuttle's safety and reliability and to provide an additional 12,000 pounds of payload capacity. To date, the new motor's estimated development cost has more than doubled--to $3.8 billion--and its first flight has slipped by about 6-1/2 years--to the end of 2000, at the earliest.

NASA advisory groups have questioned the need to develop the new motor because the current motor has proven safe and reliable since being redesigned after the Challenger accident. Moreover, the only two payloads that would require the new motor's added lift are the

Advanced X-Ray Astrophysics Facility and the space station's laboratory modules. As noted previously, the astrophysics facility has been redesigned into two smaller payloads, and the smaller of the two will be launched by an expendable rocket.

The space station is also being redesigned, and it does not appear that it will need the Advanced Solid Rocket Motor either. According to the report of the Advisory Committee on the Redesign of the Space Station, the new motor will not be required to launch the redesigned station. The Committee noted that even if NASA decides to put the station in the type of orbit that requires more shuttle capability, that capability can be obtained in a number of ways that do not require the new motor.

The House-Senate conference committee on NASA's fiscal year 1994 appropriations provided about half of the funding requested for the new motor's development. The committee also gave NASA until November 16, 1993, to determine whether it wants to continue the program and identify the source of the program's additional funding.

IMPROVING OPERATIONS AND OVERSIGHT

NASA can improve its efficiency and effectiveness by improving oversight of its program offices, field centers, and contractors, thereby reducing the risk of inconsistent and substandard performance. Specifically, NASA

-- needs a Chief Financial Officer to provide the strong and sustained leadership needed to correct the agency's substantial and long-standing accounting and financial management weaknesses;

-- must find ways to operate its most expensive program--the space shuttle--more efficiently, since the shuttle will have to continue

as NASA's major means of access to space well into the early part of the 21st century;

-- needs to improve its procurement policies and procedures to help make its contracting activities more efficient and better protect the government's interest; and

-- should provide the budgetary support needed to correct weaknesses in the testing of space projects, in the storing and archiving of space science data, in maintaining its facilities, and in establishing and operating adequate environmental protection programs.

Reporting Under the Financial Integrity Act and Need for a Chief Financial Officer

Recently we reported that NASA's annual report, required by the Federal Managers' Financial Integrity Act, did not accurately characterize or fully disclose the weaknesses in NASA's internal management controls or the failure of its accounting systems to conform to the Comptroller General's accounting principles and standards. Almost 90 percent of NASA's budget is spent on procuring goods and services, and sound procurement decisions in NASA are largely dependent on sound financial management systems. However, NASA's accounting and financial management systems have serious material weaknesses that hamper NASA's ability to safeguard, manage, and control its budget authority. For example:

-- Contractors' periodic cost reports, which are a key source of data for program, project, and contract management information systems, were often late, insufficiently detailed, and sometimes not received at all.

-- NASA had not performed required reconciliations between subsidiary and general ledger accounts as required by the Comptroller General's accounting standards.

--NASA's internal financial controls did not ensure that the type and value of government property held by contractors were accurately reported.

NASA needs to comply with the Chief Financial Officers Act of 1990 and, through its Chief Financial Officer, ensure the correction of deficiencies in its accounting and financial management systems. The NASA Administrator recently assured the Comptroller General of his commitment to correct the agency's deficiencies within the intent of both the financial integrity and chief financial officers acts. He also acknowledged the urgency of having a Chief Financial Officer to establish broad financial management leadership.

Improving Shuttle Operating Efficiency

NASA has recognized the need to reduce the cost of its most expensive program--the space shuttle. Currently costing at least $4 billion a year, operating the shuttle system consumes over 30 percent of NASA's total budget. NASA wants to lower this proportion and has established a goal to reduce shuttle operating costs by 25 percent by fiscal year 1997. Accomplishing a reduction of this magnitude will require the streamlining or elimination of many flight processing procedures and related documentation requirements. In doing so, special care will be required to see that these efforts do not compromise safety, either on the ground or in flight.

Because the shuttle is the only U.S. vehicle for carrying humans into space, and it is likely to remain so well into the first two decades of the 21st century, NASA must continue to upgrade shuttle

components and subsystems to prevent obsolescence and maintain or enhance the shuttle's safety margins.

Improving Procurement and Contract Management

Since the late 1980s, primarily on the basis of reviews performed by the NASA Inspector General and its own internal management studies, NASA has recognized contract and subcontract management as a material weakness under the financial integrity act. NASA contract management also has been identified as a high-risk area by the Comptroller General, and our work in this area over the last several years has addressed major contract management activities in NASA, including its management of contract changes and its coordination and oversight of contract administration services it requests DOD to perform. Our work confirms NASA's view that it has serious contract management problems.

NASA has been working to improve its management of contracts. At the same time, the agency is attempting to increase the efficiency of its procurement activity. For example, NASA has taken, or is considering a variety of steps to improve procurement efficiency and contractor accountability, including

--simplifying procedures on procurements valued between $25,000 and $500,000,

--increasing contractor liability for correction of defects in material or workmanship,

--changing its award fee policy to emphasize performance of the finished product rather than progress in meeting interim goals,

--reporting semiannually to senior NASA management on contractors' performance on key contracts,

--awarding 8 percent of NASA's contract dollars to small businesses and other organizations owned or controlled by socially and economically disadvantaged individuals, and

--reducing the number and value of the agency's unpriced contract changes.

We are currently reviewing NASA's progress in implementing these initiatives at the request of the House Committee on Government Operations. We expect to report on the results of our work in early 1994. Also at the Committee's request, we are examining another area of contractor oversight--reviews of contractors' overhead cost submissions on NASA contracts. NASA relies on other organizations, principally the Defense Contract Audit Agency, and the Defense Contract Management Command to review the cost submissions and to determine whether overhead costs are allowable under the Federal Acquisition Regulation. At the Committee's request, we are currently examining the extent to which unallowable or questionable overhead costs were submitted for reimbursement by two major NASA contractors. The preliminary results of our work at the first contractor shows that the overhead cost submissions included some unallowable and questionable costs because (1) the contractor's internal controls for screening them out were inadequate and (2) the Defense Contract Audit Agency's transaction testing was inadequate to assess the effectiveness of such controls. For example, we found unallowable costs for expenses relating to lobbying activities. Our work at the first NASA contractor is currently being finalized, and we will be reporting to you shortly. Our work at the second contractor has only recently begun.

Other Operations and Oversight Improvement Opportunities

On the basis of our work over the past several years, we believe there are some other areas which need to continue to receive management attention. Specifically we are concerned about long-

standing weaknesses in the area of testing space projects, storing and cataloging space science data, maintaining facilities, and establishing and operating adequate environmental protection programs. We do not believe that the budgetary pressures within the agency should be allowed to impede efforts to improve these activities. We plan to follow up on them to determine whether the recommended corrective actions have been fully implemented throughout the agency.

Space Project Testing

The recent failure of the Mars Observer spacecraft has renewed interest in NASA's space project testing policies and practices and the agency's oversight of contractor testing. Two years ago we reported that NASA's testing practices were varied because the agency had no uniform policies governing testing. Testing guidance was fragmented, not well defined, and differed from one NASA field center to another. We noted that all NASA centers had oversight controls to help ensure that contractors properly planned and conducted tests and reported their results. Controls at some centers, however, could be further strengthened if NASA (1) approved contractor-prepared plans and procedures for all critical tests, (2) conducted independent reviews of testing on major programs, and (3) provided adequate staff with the requisite skills to monitor contractor testing. In response to our report, NASA agreed that it needs an overall testing policy. The policy is scheduled to be issued early this fiscal year.

Science Data Management

NASA's programs over the years have generated enormous amounts of space science and engineering data, some of it potentially useful to future missions--the Earth Observing System for example. All this data makes NASA an archivist--a role the agency has not performed especially well. In 1990, we reported that NASA was not

74-136 O - 93 - 2

retaining data from some important missions and was not requiring missions to have data management plans. We also found widely varying and potentially harmful physical storage conditions throughout NASA. In response to a request from a House subcommittee, we recently reviewed NASA's efforts to respond to our past recommendations to establish more effective management controls for properly storing space science data and for identifying and cataloging data having potential long-term scientific value. We expect to report later this fall on the status of NASA's efforts.

Facilities Maintenance

In 1990, we reported that many of NASA's facilities had not been adequately maintained, were in degraded condition, and needed significant repair. Several serious incidents had been caused by the facilities' deterioration, including a fire and steam line explosion. Deferred or insufficient maintenance increased the likelihood of such events, as well as the cost of maintenance over the long run.

For the most part, the responsibility for maintaining NASA's facilities had been left to the discretion of the field centers. Historically, NASA had not conducted annual surveys to determine maintenance requirements and had allocated far fewer funds than the 2 to 4 percent of facilities' replacement value that generally accepted maintenance guidelines dictated. We made a series of recommendations to NASA that were designed to help establish an agencywide facilities maintenance program. Since our report, NASA has completed action on our recommendations. We will revisit this area this year to determine if NASA is reversing the deterioration of its facilities.

Environmental Protection Activities

Several years ago, we reported on the absence of a systematic, agencywide program for environmental protection. NASA knew that it had a variety of environmental problems at its field centers due to both its own activities and those of previous military owners, and it had undertaken or planned many cleanup projects. However, the costs of these projects were unknown, and the extent of the needed cleanup was unclear because studies of many contaminated sites were not completed.

As with facilities maintenance, NASA delegated the responsibility for environmental protection to the field centers without having an agencywide strategy and an effective monitoring and management system. We made a series of recommendations designed to develop standards, guidelines, reporting requirements, and information-sharing arrangements that would foster an agencywide approach to identifying and correcting environmental problems. NASA has implemented most of our recommendations and is currently completing action on the rest. We will review NASA's efforts to correct its environmental problems this year.

PRESERVING U.S. AERONAUTICS LEADERSHIP

Foreign companies have been making significant gains in the global market for aeronautics products at the expense of U.S. manufacturers. This is especially disturbing because the aerospace industry provided a $29 billion positive contribution to the U.S. trade balance in 1991.

The National Aeronautics and Space Act of 1958 charged NASA with preserving the role of the United States as a leader in aeronautical science and technology. In testimony last year we noted that funding for NASA's aeronautics program had been limited

and, over the past 20 years, it had declined as a percentage of the overall NASA budget. Also, we noted that (1) the program was weighted heavily towards fundamental research that was not especially supportive of the aircraft industry's near-term competitiveness needs, and (2) NASA was having difficulties supporting the wind tunnel test requirements of major U.S. aircraft companies. After our testimony, and the issuance of a subsequent National Academy of Science report with similar findings, NASA's aeronautics program began to receive increased attention. The President's fiscal year 1994 budget proposed increased aeronautics research funding, especially for large subsonic transport jets--the market area with the greatest near-term sales potential. The budget proposal also would upgrade and revitalize NASA's aeronautic testing facilities including wind tunnels.

In continuing our focus on the aeronautics area, we recently completed work related to NASA's responsibility to transfer technology to the U.S. aeronautics industry--reviewing NASA's management of both its aeronautical technology transfer and technology protection responsibilities.

We found that in managing its transfer activities, NASA does not have an adequate system to comprehensively monitor and measure the ultimate applications of the technologies it develops. Without this information, the agency is not in a position to focus its resources on preserving the international competitiveness of the U.S. civil aeronautics industry and cannot readily determine the impact of its technology transfer activities on the industry's competitiveness. NASA recognized this problem, and late last year the Administrator issued a directive giving technology transfer an increased emphasis within NASA. The directive endorsed the need for NASA's field centers to be responsible for, and to be evaluated on, their technology transfer performance and provided an initial approach for systematically gathering information on both the process and effectiveness of technology transfer.

Along with its enabling legislative mandate to provide the "widest practicable and appropriate dissemination of information," NASA recognizes a concurrent responsibility to protect competitively sensitive research results from inappropriate disclosure. NASA believes that, as a leader in the development of key aerospace technologies, it is vulnerable to economic espionage. This belief, coupled with a change in global economic competition, has made NASA cautious about sharing technical information internationally.

However, NASA's caution is potentially affected by the requirements of the Freedom of Information Act, which requires federal agencies to promptly make agency records available to anyone who requests them, including representatives of foreign governments or companies. NASA records that contain competitively sensitive information are not necessarily covered by any of the nine exemptions from disclosure under the act.

To help control the potential for inappropriate dissemination of competitively sensitive information, NASA sometimes strictly interprets a Freedom of Information Act requirement for a reasonable description of an agency record in order to deny requests. NASA also interprets the concept of national security under the Arms Export Control Act as covering competitive sensitivity when it reviews and recommends amendments or denials to export license applications.

In our review at two of NASA's three aeronautical centers we did not find that NASA was transferring competitively sensitive aeronautical information to U.S. industry's foreign competitors. However, NASA remains concerned about its potential vulnerability and, earlier this year, the Associate Administrator for Aeronautics initiated a process to develop a new policy addressing the identification, handling, measurement, and tracking of competitively sensitive information. NASA expects to have the new policy in place this fiscal year.

OBSERVATIONS

Given the risky nature of its business, NASA will likely have failures along with its successes. The key requirement is to do everything that reasonably can be done to ensure success under an affordable program. Unfortunately, this requirement is not currently being met, as amply demonstrated by our work and that of the NASA Inspector General, other external review groups, and the agency's own internal management review groups. Clearly, NASA has significant management problems that it needs to vigorously address.

The issues included in my testimony today are largely known to NASA management and, in varying degrees, are currently being addressed within the agency. The most hopeful sign we see for the future of NASA is a somewhat intangible one--NASA as an agency determined to identify and confront its problems. However, the challenges facing NASA's management are not easy ones to surmount. Their significance has been slowly building over a long period--in some cases, for decades--and many are deeply embedded in the way NASA has traditionally done business. Indeed, when viewing these challenges, we must bear in mind that NASA operates largely in a decentralized fashion, with its field centers having considerable operating latitude in many areas, including the award and administration of almost all of the agency's contracts. For this approach to be effective, headquarters must establish clear expectations and carefully monitor and measure the centers' management of their own activities, as well as those of NASA's contractors.

While NASA's senior management's commitment to improvement is promising, delivering on it will require development and maintenance of new and improved management systems and demand perseverance and strong leadership to overcome long-standing attitudes and practices that uncritically extol tradition and

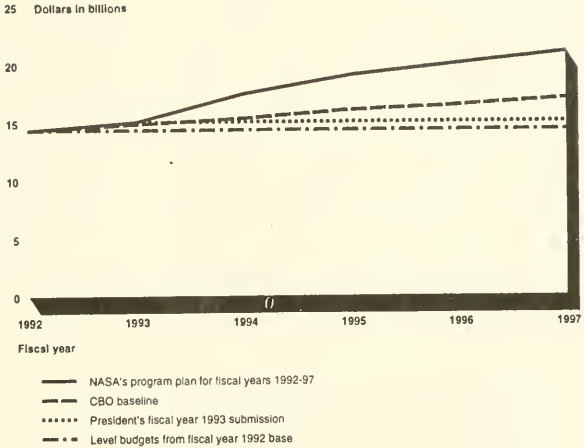
resist change. Continued vigorous oversight will be required to ensure an affordable and effective NASA.

- - - - -

Mr. Chairman, this concludes my statement. I will be pleased to answer any questions you or the members of the subcommittee may have.

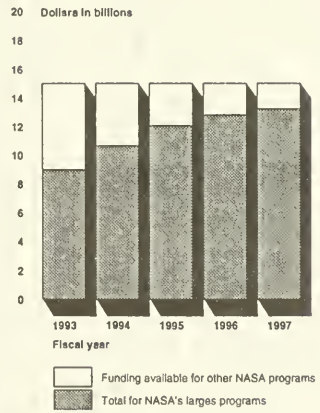
(709045)

GAO Potential Shortfalls in Funding NASA's 5-Year Plan



ATTACHMENT I

GAO Funding for NASA's Programs Reduce Resources for Other Programs



ATTACHMENT II

Mr. CONYERS. Now let's just get one thing clear. Did I overstate anything or is there some embellishment or exaggeration in my interpretation of the several reports and studies your organization has been working on?

Mr. CONAHAN. No, I think not. I think that your opening statement was a good summary of the body of work that we have done over a long period of time. If you start, for example, with the financial management system, it is fraught with deficiencies. It does not permit the agency to have overall visibility and control over its assets stewardship over the activities and programs entrusted to that agency.

I think you will hear from Mr. Colvin soon about the audit that he attempted to do of the agency's financial statements. I will leave that for him to say. But his comments will just echo the concerns that we have had with financial management generally in that agency.

In addition to the problems that exist, we don't think that the agency has adequately characterized the weaknesses that it has in its management and operations.

Mr. CONYERS. Well, you wouldn't consider yourself as one of the people that would have stopped Columbus from being funded for exploration, would you? Do you fall into that nay sayer category, let's not experiment, let's not try out new things because they might fail? Is that the kind of attitude you bring?

Mr. CONAHAN. Mr. Chairman, I would like to speak to that, maybe give you a longer answer than you are asking for, but as you well know, I deal with this committee on matters involving national defense as well as other areas.

Following the Persian Gulf campaign, there was a good bit of press pointing out that GAO had recommended that all those wonderful systems that worked over there be killed and terminated. That was absolutely untrue. We have not really, with one or two exceptions, recommended over the years that individual weapons systems be terminated.

What we have done is to make recommendations to improve the acquisition process under which those programs are procured. I think that is what we are here about today. We are not here to say stop space exploration. We are not here to say stop science or anything of that nature. What we are saying is that we have a very expensive operation over there, and that they don't think that they have adequate management systems to bring about efficiencies and effectiveness in that operation.

Mr. CONYERS. So Columbus could have used a little expertise like GAO around and been a little more efficient maybe, and some of these other great scientific activities. In other words, this isn't a pro or con that we don't need to know about the mysteries of outer space and the great challenge that space has in the scientific realm, but that we do have to observe very simple accounting principles. It seems to me that is the attitude that you really bring to this discussion.

Mr. CONAHAN. Hopefully we do. We have met with the administrator and his top people several times. We meet with center directors as well as people out in the field, all with the view of working together with them to bring about correction of the problems that

exist out there that get in the way of increased efficiency and effectiveness.

Mr. CONYERS. Well, thank you.

Inspector General Colvin, what I think you have stated in writing to this committee, and we have had a lot of talking back and forth, here is one allegation, 288 percent profit margins by companies which are NASA contractors. That is price gouging in my mundane world. Millions of dollars in award fees paid contractors who have not earned them, NASA workers literally asleep on the job with almost half the workers on some shifts doing little or no work at all, fraudulent certification of transistors and other critical electronic parts that could result in loss of life and that the inspector general found little assurance that these parts could perform as designed. Such failures are believed to be responsible for the loss of the Mars Observer probe and a new weather satellite. Have I condensed some of your statement correctly?

Mr. COLVIN. Yes, sir, you have condensed it very accurately. I would like to make one point there, Mr. Chairman, if I could, and that in reference to the employees that were found asleep, those were not civil servants but contractor employees. Indeed, our review would indicate that where there was a civil servant present, there was better productivity.

Mr. CONYERS. I am glad to hear that. Could you make any comments that you would like, Mr. Inspector General, in view of the fact that your entire statement is included in the record.

STATEMENT OF BILL D. COLVIN, INSPECTOR GENERAL, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Mr. COLVIN. Yes, Mr. Chairman, if you would, I have some oral remarks that I would like to make.

First of all, Mr. Chairman and members of the subcommittee, I do appreciate the opportunity to testify today on the audit and investigative oversight work of the NASA Office of Inspector General and also, Mr. Chairman, to thank you for your strong support of the inspectors general.

My testimony is divided into the following major areas: procurement oversight; product integrity; financial related activities; and proactive NASA program evaluations. I will present a summary of my statement, and I appreciate that my formal statement will be submitted for the record.

Procurement oversight. In fiscal year 1992, NASA's procurements totaled $13.5 billion as compared to agency appropriations of $14.3 billion. Approximately 79 percent of the procurements were placed directly with business firms. With over 90 percent of the agency's budget directed to procurements, my office has directed a significant amount of attention to evaluating the economy and the efficiency of operations, measuring procurement effectiveness, and the detection of fraud, waste, and abuse. I would like to share with you some of those accomplishments.

First, Mr. Chairman, I am very pleased today to announce that as a result of our investigation, a $25 million settlement was reached with contractors to resolve the legal liability for the Hubble space telescope spherical aberration. My investigation re-

veals that the contractor knew or should have known of the spherical aberration and that this data was withheld from NASA.

I believe this to be a fair settlement, given the technical and legal complexities associated with the investigation. As a matter of fact, I consider the development of this case and its negotiation to be a model to emulate, a case in which various disciplines in criminal investigations, law, accounting, contract specialists, optics experts and engineering from both the program and the IG side of the agency worked together as a team to produce a positive result for U.S. taxpayers. It could not have been accomplished without the team effort and the strong support of the NASA Administrator and his desire to instill accountability in his contractors.

Excessive award fees. My office examined the area of award fee contracting, including the contractual feature known as rollover which permitted contractors to earn in subsequent periods award fees they had failed to earn in prior performance periods. We found that contract cost overruns were not adequately considered as part of the cost incentive evaluation criteria in determining the award fee amount. As a result, contractors have earned millions of dollars in award fees on contracts experiencing hundreds of millions of dollars in cost overruns.

Additional award fee process issues needing improvement include award fee processing time, use of retroactive award fee adjustments, recognition for minimal acceptable performance, and following award fee scoring guidance. We identified almost $6 million of cost avoidances that NASA could realize.

In response, NASA removed all available award fees from the allowable cost category for one contract reviewed, and agreed to issue guidance emphasizing the need for the technical cost, and schedule accomplishments when considering award fees.

I also want to note that in the Hubble settlement, I mentioned earlier $3.5 million in award fees have been forfeited. I appreciate NASA's response to my recommendations, and I reiterate that we must hold our employees and our contractors accountable and not accept less than quality performance and workmanship.

Excessive wage rates. An agencywide audit of nonunion employee wage rates found NASA was paying excessively for labor on cost-type support service contracts. Compensation reviews performed by DCAA on 15 of NASA's top 25 support service contracts identified an excess of $8 million in excess labor costs because compensation reviews were not performed and contractors failed to use wage survey data that would have assisted NASA in determining the reasonableness of wages. We estimated NASA could save $56.4 million over the remaining life of the contracts if wage rates more closely resembled those in the prevailing marketplace.

On the issue of leasing, facility and equipment leases have also posed problems. Audits performed at two NASA centers disclosed that facility acquisitions were being classified as operating leases rather than as capital leases. Reclassifying these leases could have saved NASA over $40 million due to the extended period capital leases recognize and the accompanying differences in accounting treatment of lease costs.

Similarly, an audit conducted of equipment acquisitions and on-site contractor procurements revealed contractors misclassified

leases for vehicles and equipment. In addition, leasing of equipment results in increased costs. For example, the use of a lease arrangement rather than direct purchase of a super computer resulted in additional financing and overhead costs of approximately $9 million and unnecessary contractor profits of about $2 million.

Contract administration. For sometime GAO has been concerned about the effectiveness of NASA's controls over its annual contract administration and support requirements. DOD support to NASA contract administration was costing NASA $60 million annually. My office found that NASA may be unduly relying on DOD's requirements estimates and sufficient attention was not being given to the billing rates charged to NASA.

Investigative activity. My staff has devoted and does devote substantial resources to procurement-related investigations, the Hubble case mentioned earlier being only one example. We performed, Mr. Chairman, an analysis of investigative activities involving NASA's top 10 contractors over the past 10 years. A chart depicting this analysis appears on page 4 of my written statement.

Now the analysis showed that nine of these contractors were identified with investigative activity, eight repetitively so. In my opinion, it illustrates a surge for the current period and is expected to continue for the foreseeable future.

During the period fiscal year 1990 to 1992, $32 million, or 98 percent of the dollar recoveries resulting from OIG investigations, were obtained from procurement fraud issues. Also, 41 or 55 percent of the criminal convictions obtained during that period resulted from procurement fraud investigations. While self governance, voluntary disclosure, and ethics programs are practiced by contractors, they are not a panacea nor a substitute for government oversight. Where a contractor is able to police itself adequately, the government can spot check for compliance when appropriate, thus freeing precious resources to concentrate on other matters.

The point I want to make here is that in my opinion as the government does more with less and as American industry scales back, someone forgot to tell the bad guys. My statistics show an increased investigative activity and my 50 criminal investigators are pursuing roughly 450 criminal investigations at any given point in time.

Mr. CONYERS. Is this in NASA?

Mr. COLVIN. This is in NASA.

Mr. CONYERS. Alone?

Mr. COLVIN. Alone, that is correct.

Mr. CONYERS. How many?

Mr. COLVIN. Roughly 450 investigations.

Mr. CONYERS. Each one of them separate?

Mr. COLVIN. That is correct. I would like to shift now to financial-related activities, Mr. Chairman, and particularly the chief financial officers compliance.

In June 1993, we completed our first audit of NASA's financial statements as required by the Chief Financial Officers Act. We reviewed NASA's statements to determine if they were fairly presented, if internal financial controls were adequate, if funds and other assets were properly safeguarded, and obligations were in accordance with applicable laws and regulations. What I found was

that of NASA's $33 billion in book assets, we were unable to reconcile 37 percent or over $12 billion. Of NASA's $3 billion in liabilities, we were unable to reconcile over 34 percent or in excess of $1 billion. Of NASA's $14 billion in current year costs, we were unable to reconcile 32 percent or over $4 billion.

Now because suitable documentation was not provided, we did not express an opinion on the fiscal year 1992 statements or to say that in another way, in my opinion the financial statements are unauditable. Documentation for selected accounts could not be reconstructed, put into usable form or were received too late to be used.

I considered NASA's financial and accounting systems to be a material weakness, reportable under the Federal Managers Financial Integrity Act, and a high-risk area in need of increased attention. A successful audit of 1993 financial statements will depend on a more positive and a concerted effort by NASA financial managers and the IG auditors. We are working together, but, Mr. Chairman, NASA urgently needs a chief financial officer in my opinion.

We also looked at Antideficiency Act compliance. In my opinion, NASA centers had five technical or administrative violations of the Antideficiency Act as of September 30, 1991. These violations required reporting in accordance with NASA's governing regulations and statutes. The violations were validated from among 22 GAO reported instances totaling $13 million where six NASA centers may have exceeded authorized funding. The violations were caused by accounting errors and internal control breakdowns such as not regularly reconciling funding authorization documents to center financial records.

Mr. CONYERS. Did you say September 1991?

Mr. COLVIN. Yes, sir, I did.

Mr. CONYERS. Then what about the possibility of additional violations of the Antideficiency Act between that date and this present one?

Mr. COLVIN. Mr. Chairman, we did not identify any additional potential violations there, but my concern is that because the errors and conditions that existed at that point in time still exist today, that potential still exists.

Mr. CONYERS. Thank you.

Mr. COLVIN. Because funding authorizations were not exceeded at the appropriations level, NASA financial management officials disagreed with characterizing the errors as violations of the Antideficiency Act. However, they have agreed to make changes to insure that the situations we found during the review would not recur.

Based on NASA's internal guidance which requires that funding be controlled at the center level, I continue to believe that the administrative violations of the act did occur.

I would like to speak to some of our proactive program evaluations. The Vice President's report on the National Performance Review advises reorienting the inspectors general from strict compliance auditing to evaluating management control systems. In the future, the inspectors general should not only look for waste, fraud, and abuse but also help improve control systems to prevent fraud, waste, and abuse and ensure efficient and effective service.

I have been advocating more program and project audits as is contained in my own long-term vision statement and incorporated into my budget justifications. I have a number of ongoing initiatives which I believe are within the spirit of the NPR recommendation. We are doing work on space station, we are doing work on the Advanced Solid Rocket Motor, Spacehab and the Consortium for International Earth Science Information Network, and the issues raised by these ongoing audits and assessments give the Congress and NASA the opportunity to appropriate and expend funds in a more efficient and economical manner, in a way which permits us to report positively on funds put to better use rather than negatively on funds unwisely spent. Consideration of these up front allows the agency to proceed with these programs, knowingly and intelligently, and on a fiscally sound basis.

We are also involved in other proactive areas to assist the agency in their management, but in summary, Mr. Chairman, I believe NASA's Office of Inspector General has made and will continue making significant contributions to the improvement of NASA programs and operations. We have assessed and had a hand in improving key operational areas within NASA such as procurement and product integrity. Where necessary, we have ferreted out waste, fraud, and abuse in these areas.

We have also devoted a large amount of resources in assisting NASA to improve its financial management system and budgetary control processes. We are also moving vigorously into program and project evaluation, working cooperatively with agency managers. Our work in these areas has potential to improve the integrity of NASA's programs and to make better use of the taxpayers' dollars.

In responding to our work, NASA management has been aggressive in pursuing corrective actions, and while much progress has been made, much more remains to be done. Our plan is to move even more aggressively into indepth analyses of NASA's programs. I believe that in this way the OIG can become a full partner in improving NASA's diverse missions.

Thank you, Mr. Chairman, and I will be glad to respond to any questions.

Mr. CONYERS. Well, thank you very much, Mr. Inspector General.

[The prepared statement of Mr. Colvin follows:]

National Aeronautics and
Space Administration

Hold for Release Until
Presented by Witness

October 6, 1993

Subcommittee on Legislation and National Security

Committee on Government Operations

U.S. House of Representatives

Statement by:
Bill D. Colvin
Inspector General

Hold for Release Until
Presented by Witness

Statement of

Bill D. Colvin
Inspector General

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

before the

Subcommittee on Legislation and National Security
Committee on Government Operations
U.S. House of Representatives

Mr. Chairman and Members of the Subcommittee, I am pleased to testify today on the audit and investigative oversight work the NASA Office of Inspector General performs at the Agency and among its contractors, and how this work relates to NASA's efforts at management and procurement reform. My testimony is divided into the following major areas: procurement oversight; product integrity; financial related activities; and, proactive NASA program evaluations.

I. PROCUREMENT OVERSIGHT

In fiscal year 1992, NASA's procurements totalled $13.5 billion as compared to Agency appropriations of $14.3 billion. Approximately 79 percent of the procurements were placed directly with business firms, another 9 percent with the California Institute of Technology for operation of the Jet Propulsion Laboratory and 12 percent with educational, nonprofit, other Government agency or outside U.S. interests. With such large amounts directed to Agency procurements, my office has directed a significant amount of attention to evaluating the economy and efficiency of operations, measuring procurement effectiveness, and the detection of fraud, waste and abuse. I would like to share with you some of our accomplishments.

A. AUDIT ACTIVITY

Subcontract Management

Subcontract management reviews performed at three major NASA centers revealed that work performed by subcontractors on NASA prime contracts was frequently overpriced and prime contractors were not achieving adequate competition in awarding

subcontracts. In one instance, profits ranging from 28 to 288 percent were realized on 41 percent of the subcontracts reviewed. Our audits determined that the number of contracts awarded noncompetitively ranged from 63 to 86 percent. These conditions resulted in NASA reimbursing contractors about $40 million in costs that we believe could have been avoided. NASA instructed its centers to focus greater attention on subcontractors, and developed incentives for prime contractors to improve subcontract management, including competition and pricing.

Excessive Award Fees

My office examined the area of award fee contracting, including a contractual feature known as "rollover," which permitted contractors to earn in subsequent periods award fees they had failed to earn in prior performance periods. We found that contract cost overruns were not adequately considered as part of the cost incentive evaluation criteria in determining the award fee amount. As a result, contractors have earned millions of dollars in award fees on contracts experiencing hundreds of millions of dollars in cost overruns. Additional award fee process issues needing improvement include: award fee processing time; use of retroactive award fee adjustments; recognition for minimal acceptable performance; and following award fee scoring guidance. We identified $5.8 million in cost avoidances that NASA could realize. In response, NASA removed all available award fee from the allowable cost category for one contract reviewed, and agreed to issue guidance emphasizing the need for technical, cost and schedule accomplishments when considering award fees earned.

Excessive Wage Rates

An agency-wide audit of nonunion employee wage rates found NASA was paying excessively for labor on cost-type support service contracts. Compensation reviews performed by DCAA on 15 of NASA's top 25 support service contracts identified $8.1 million in excess labor costs because compensation reviews were not performed and contractors failed to use wage survey data that would have assisted NASA in determining the reasonableness of wages. We estimated NASA could save $56.4 million over the remaining life of the contracts if wage rates more closely resembled those in the prevailing market place. NASA agreed to promote the use of wage surveys and directed center procurement officers to closely monitor contractor employee compensation.

Low Productivity of Contractor Employees

Insufficient contract monitoring was evident in reviews of NASA contractor employees. On-site contractor floorchecks performed at five NASA centers disclosed that many employees were asleep while on duty, engaged in personal activities when they should have been actively working, and had job charges completed in

advance on their time cards. The most prevalent abuses involved third-shift contractor employees. For the centers surveyed, we found 105 of 241 (44 percent) third-shift employees engaged in activities unrelated to the contract. The potential exists that third-shift non-productivity could be costing NASA an estimated $32 million per year or $103 million over the average remaining life of the contracts. Since the audit, NASA center procurement officials have implemented regular floorchecks of second and third shifts and requested DCAA to increase its emphasis on floorchecks.

Misclassification of Leases

Facility and equipment leases have also posed problems. Audits performed at two NASA centers disclosed that facility acquisitions were being classified as operating leases rather than as capital leases. Reclassifying these leases could save NASA over $40 million due to the extended period capital leases recognize and the accompanying differences in accounting treatment of lease costs. Similarly, two audits conducted of equipment acquisitions and on-site contractor procurements revealed contractors misclassified leases for vehicles and equipment, and leased rather than purchased super computers. Proper acquisition of these items could generate savings in excess of $9 million.

Contract Administration

For some time, I have been concerned about the effectiveness of NASA's controls over its annual contract administration and support requirements. DOD support to NASA contract administration was costing NASA $60 million annually. My office found that NASA may be unduly relying on DOD's requirements estimates and sufficient attention was not being paid to the billing rates charged to NASA. NASA has issued revised policy guidance in this area, and taken a more active role in managing, funding, and authorizing payment for contract administration and audit services performed by other U.S. Government organizations.

B. INVESTIGATIVE ACTIVITY

My staff has devoted substantial resources to procurement related investigations. We performed an analysis of investigative activities involving NASA's top 10 contractors over the past 10 years. The analysis showed that nine of these contractors were identified with investigative activity, eight repetitively so, as depicted in the chart below.

Each "X" represents one or more contractor related criminal, civil, and/or administrative investigations conducted by the OIG or by other law enforcement organizations that produced results and was closed during each fiscal year up to and including FY 1993. The last column shows on-going NASA OIG

investigations only. It should be noted that the contractors are not listed in any particular order, nor are they identified so as to protect the viability of on-going investigations.

NASA's TOP 10 CONTRACTORS

INVESTIGATIVE ACTIVITIES

CONTRACTOR	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1997
A							X					X
B		X						X				X
C												
D			X			X	X	X	X			X
E			X									X
F					X	X		X				X
G						X		X	X		X	X
H			X	X	X	X	X		X	X		X
I												X
J	X	X	X			X						

A surge of investigative activity is illustrated for the current period and expected to continue for the foreseeable future. During the period FY 1990 to 1992, $32 million (98 percent) of the dollar recoveries resulting from OIG investigations were obtained from procurement fraud issues. Also, 41 (55 percent) of the criminal convictions obtained during that period resulted from procurement fraud investigations. While self-governance, voluntary disclosure, and ethics programs are practiced by contractors, they are not a panacea nor a substitute for Governmental oversight. Where a contractor is able to police itself adequately, the Government can spot check for compliance as appropriate, thus freeing precious resources to concentrate on contractors whose activities are more suspect.

Examples of our contractor related investigative work are summarized below:

- o A joint OIG/FBI investigation resulted in the indictment of a NASA employee for selling computer-related equipment developed under a NASA contract for private gain. The indictment alleges

that the employee entered into financial relationships with contractors over whom the employee exercised contract monitoring responsibilities. The equipment and software were exclusive to NASA at the time the employee offered them for sale and were not available elsewhere. The indictment also alleges the employee used Government facilities, schematic drawings, testing equipment, as well as Government and contractor personnel to deliver the equipment sold.

- An OIG investigation, supported by DCAA, recovered $394,000 charged to NASA contracts for a building leased by a contractor for its employees to prepare a proposal for an unrelated contract. The costs were billed to NASA contracts through the contractor's overhead rates.

- An OIG investigation determined that a contractor had improperly allocated foreign selling costs to two NASA contracts. The costs were allocated to the contracts prior to implementation of a Federal Acquisition Circular which permitted the practice. The contractor credited over $438,000 to the contracts.

- A joint OIG/Defense Criminal Investigative Service (DCIS) investigation of a contractor's mischarging costs to a major NASA program resulted in the contractor and one employee entering into a pretrial diversion agreement and the contractor repaying the Government over $6.9 million.

- An OIG investigation into alleged defective pricing involving a leasing arrangement for a super computer resulted in the recovery of approximately $1.2 million and a cost avoidance of approximately $3.5 million. A DCAA audit found that a contractor did not inform NASA negotiators that it was planning to buy and then assign the computer equipment to a subcontractor. The audit found that the contractor received excessive profits because the interest rate it quoted to the Government was higher than that which it was charged by the subcontractor.

C. NASA PROCUREMENT REFORMS

While OIG audits and investigations continue to surface problems in various NASA programs, NASA, to its credit, is continuing to take strides toward remedying these problems. Management initiatives are being undertaken concurrently in support of NASA's commitment to procurement reform. Some key initiatives are listed below.

- o Incentive Contracting
- o Contract Management Improvement
- o Mid-Range Procurement (Pilot Test Program)
- o Parallel Negotiation of Contracts
- o Small Disadvantaged Business Program

While we believe that all the initiatives should ultimately improve NASA's procurement processes, it is too early to conclude what impact the initiatives will have.

II. PRODUCT INTEGRITY

In previous sessions of Congress, I testified on deficiencies in the aerospace fastener and triple E parts industry. Our achievements in these areas have resulted in our securing convictions and recoveries, and more importantly, improved mission safety. I will highlight these very important reviews.

Aerospace Fasteners

As the result of problems associated with fasteners used on NASA flight hardware, my office performed reviews of aerospace fastener manufacturers and distributors. Our work disclosed that fastener certifications were often unsupported by test results. Product reviews of 17 fastener manufacturers showed that some certification statements were not supported by documented test results or testing was inadequate. Of the 17 manufacturer reviews conducted, 6 resulted in the issuance of product quality alerts. The installation of untested or undertested fasteners in flight hardware could have severe consequences.

In addition, we took exception to the nontraceability of fastener products in NASA and contractor inventories. For example, we found aerospace bolts that did not contain manufacturer identification symbols. Without these symbols, it is difficult for NASA to trace suspect fasteners when problems surface. Further, fastener stocks were not traceable to procurement documents, supplier certifications, and/or to supporting test results. For one contractor reviewed, about 75 percent of the total fastener inventory was stored by part number and was not traceable to manufacturer lot number.

Our concerns increased when we noted that current disposal practices for uncertifiable fasteners did not preclude their false recertification and resale to the Government, or to the public, for use in private or commercial aircraft. As a result of our efforts, NASA revised its policies to include establishing quality assurance standards that provide for the

independent testing of fastener products, requiring observation of testing at manufacturing sites, and subjecting suppliers to comprehensive product reviews.

We also have conducted a number of successful investigations in this area. For example, a recently completed joint OIG/DCIS investigation confirmed that a contractor had improperly tested fastener products between 1982 and 1989. The Department of Justice and the contractor negotiated an agreement whereby the contractor repaid the government $2.5 million.

Triple E Parts

Electrical, electronic, and electromechanical (triple E) parts consist of resistors, capacitors, diodes, transistors, wire and cable. They are used in critical flight and ground support equipment. As such, they are subject to higher reliability test requirements. Our audits found there is little assurance that triple E parts used in critical applications meet specified performance requirements. This means, for example, that resistors used in critical circuits may not perform as designed. This could result in loss of mission and life. While we found no deficient parts, the potential for using nonconforming parts is high because traceability of triple E parts is lacking. Manufacturers and distributors do not usually have objective evidence of quality tests performed to assure the reliability of triple E parts used in critical applications. In response, NASA revised its policies on the purchase of triple E parts requiring parts identification on purchase orders and certification of test results.

We have also conducted successful investigations in this area. One such case is summarized below.

- The president and sales manager of a resistor supply company were indicted as a result of a joint investigation by the NASA OIG and DCIS. The investigation indicated that the company was re-marking resistors supplied to NASA and DOD to show raised temperature coefficients, false failure rates and incorrect manufacture date codes. Additionally, standard resistors were being re-marked to indicate that they were high reliability resistors. The company pled guilty and was ordered to pay $310,000 in criminal forfeitures and $48,000 in damages. The company president pled guilty, was sentenced to prison, and ordered to pay restitution of $172,000. The sales manager also pled guilty and was sentenced to prison. The contractor was debarred for 3 years.

III. FINANCIAL RELATED ACTIVITIES

Chief Financial Officers Act Compliance

In June 1993, the OIG completed its first audit of NASA's financial statements (FY 1992) required by the Chief Financial Officers Act of 1990 (P.L. 101-576). We reviewed NASA's statements to determine if they were fairly presented, internal financial controls were adequate, funds and other assets were properly safeguarded, and obligations were in accordance with applicable laws and regulations.

Because suitable documentation was not provided, we did not express an opinion on the FY 1992 statements. Documentation for selected accounts could not be reconstructed, put into useable form, or was received too late to use. We consider NASA's financial and accounting systems to be a high risk area in need of increased attention.

A successful audit of NASA's FY 1993 financial statements depends on a more positive and concerted effort by NASA financial managers and OIG auditors. To that end, NASA management and the OIG are working together during the next reporting period to identify the support documentation and financial data necessary to ensure that FY 1993 financial statements are auditable.

Antideficiency Act Compliance

In our opinion, NASA centers had five technical administrative violations of the Antideficiency Act as of September 30, 1991. These violations required reporting in accordance with NASA's governing regulations and statutes. The violations were validated from among 22 General Accounting Office-reported instances, totalling $13 million, where 6 NASA centers may have exceeded authorized funding. The violations were caused by accounting errors and internal control breakdowns such as not regularly reconciling funding authorization documents to center financial records.

Because funding authorizations were not exceeded at the Agency appropriations level, NASA financial management officials disagreed with characterizing the errors as violations of the Antideficiency Act. However, NASA agreed to make changes to ensure that the situations we found during the review would not recur. Based on NASA's internal guidance which requires that funding be controlled at the center level, we continue to believe that technical administrative violations of the Act did occur.

IV. PROACTIVE PROGRAM EVALUATION

The Vice President's Report of the National Performance Review (NPR) advises reorienting the Inspectors General from strict compliance auditing to evaluating management control systems. In the future, the Inspectors General should not only look for waste, fraud and abuse, but also help improve control systems to prevent waste, fraud and abuse and ensure efficient, effective service. I have been advocating more program and project audits as is contained in my long term vision statement and incorporated into my budget justifications.

I have a number of ongoing initiatives which I believe are within the spirit of the NPR recommendation. My office has been doing work on the Space Station Program, Advanced Solid Rocket Motor (ASRM), Spacehab, and the Consortium for International Earth Science Information Network (CIESIN). The issues raised by these audits and assessments give the Congress and NASA the opportunity to appropriate and expend funds in a more efficient and economical manner, in a way which permits us to report positively on funds put to better use rather than negatively on funds unwisely spent. This is ongoing work subject to change. Consideration of these issues up front allows the Agency to proceed with these programs knowingly and intelligently, and on a fiscally sound basis. It also allows the Congress to make better informed decisions during budget debates. Some examples of our work in this area are discussed below.

Additionally, members of my staff have been proactively involved in NASA teams working on such areas as functional management, support service contracting, and civilian agency contracting. This proactive approach permits us to provide our expertise to management in the development and restructuring of operations, rather than waiting until the actions have been completed and providing after-the-fact criticism.

Space Station Program Assessment

The Space Station program represents one of NASA's premier space endeavors and the next frontier for man's presence in space. The NASA Administrator asked my office to conduct an assessment of the Space Station program. We focused on cost, schedule, and performance issues, along with overall management of the effort. The assessment noted that estimates of cost overruns (at one point $1 billion on one of the main three contracts) were difficult to establish because of problems in recording and reporting such estimates. For example, cost reports sometimes included inaccurate contractor estimates to complete work. The report recommended improvements in cost reporting that would provide NASA with accurate, more reliable estimates of the costs to complete the Space Station.

In another area, serious doubts were raised about a contractor's ability to produce a quality power system for the station. The power system is an integral part of the Space Station and one of the first components to be deployed into space. We recommended an independent technical assessment of the system, including an analysis of the impact of the reduced level of planned testing and tight timeframes on the ability to timely produce and deliver a quality power system.

In June 1993, the President decided to discontinue the Freedom design and approved a smaller, less costly design. Although NASA management essentially concurred with our recommendations, the Agency is still in the process of finalizing the design and setting up a new management structure. Until these actions are addressed, it is unclear how the recommendations will be implemented.

Advanced Solid Rocket Motor (ASRM) Program

To improve the Space Shuttle's overall safety and reliability, and increase its lift capacity by approximately 12,000 pounds, NASA began developing the ASRM. Our assessment of the cost estimating and schedule changes occurring on the ASRM revealed the program may no longer be necessary, a potential savings of $2.6 billion. We found that an existing redesigned motor has proven to be safe and reliable. Also, the additional lift capacity needed to launch two of the Shuttle's primary payloads may no longer be necessary because design changes have occurred to both the Space Station and the Advanced X-ray Astrophysics Facility (AXAF). We recommended NASA reevaluate the overall programmatic need for the ASRM. NASA management nonconcurred, stating that numerous strategic planning exercises were in process, including Space Station redesign, and to review ASRM before these studies were concluded would be unproductive. We asked management to reconsider, citing cost increases, schedule slippages, and NASA's consideration of the Super Lightweight External Tank, which will offer many of the increased capabilities of the ASRM.

Spacehab

In August 1988, NASA agreed to provide shuttle launch and associated services for launching the Spacehab, Inc. commercial middeck augmentation module. The module contains 50 lockers intended for rental ($1.6 million per locker) by commercial activities. Spacehab agreed to pay NASA $28.2 million for each of six shuttle missions needed to launch the module for a total of $169.2 million. The company intended to use locker space revenue to pay for the launch services. However, Spacehab's only locker customers to date have been NASA (200 lockers over 6 flights at $184 million) and the European Space Agency (1 locker). Because of Spacehab's financial position, NASA has accelerated its usage of lockers on earlier flights to help generate greater up front revenues.

Because Spacehab has been unable to generate commercial interest in its product, NASA's contract with Spacehab has not had its intended effect of fostering the commercialization of space. It also brings into serious question the continued financial viability of Spacehab and its ability to pay launch costs. FY 1994 is a crucial decision point for NASA since additional contract progress payments will be due. If the program fails, NASA will be at risk of investing $68 million toward lockers scheduled for flights which will never be flown. We recommended that NASA: 1) justify the continued support of the Spacehab contract; and 2) if continued support is not justified, limit FY 1994 funding to the completion of two flights only.

CIESIN

Congress mandated FY 1990 funding to contract with a newly created Consortium for International Earth Science Information Network (CIESIN). CIESIN's purpose is to develop recommendations and draft plans to achieve the utilization of earth science data for research and public policy purposes.

Although NASA considered CIESIN duplicative of ongoing/planned Earth Observing System (EOS) activity, NASA approved the development of CIESIN's information cooperative network. The network will allow scientists in nonearth science fields, policy makers, and other nonearth science users to find and access EOS data products. The approval was given because it was considered supportive of global change research priorities. However, NASA does not consider the mission critical to the success of EOS.

NASA management acknowledged their lack of expertise relative to social sciences and their resulting inability to effectively direct CIESIN. Despite NASA's reservations, $41.4 million was earmarked for construction of a new CIESIN facility in Saginaw, Michigan. The facility (170,000 square feet) is projected to hold 350 employees; CIESIN currently employs 78 people. Until CIESIN's role is definitized, the proposed staffing level cannot be properly evaluated and, even at the 350 staff level, the building's size appears excessive. Our audit work is ongoing at this time.

V. CONCLUSION

In summary, Mr. Chairman, I believe that the NASA Office of Inspector General has made and will continue making significant contributions to the improvement of NASA programs and operations. We have assessed, and had a hand in improving, key operational areas within NASA such as procurement and product integrity. Where necessary, we have ferreted out waste, fraud, and abuse in these areas. We have also devoted a large amount of resources in helping NASA improve its financial management

system and budgetary control processes. We are also moving vigorously into program and project evaluation work cooperatively with Agency managers. Our work in these areas has the potential to improve the effectiveness and efficiency of NASA programs and to help make better use of the taxpayers' money. In responding to our work, NASA management has been aggressive in pursuing corrective actions such as procurement reform and renewed efforts to improve its financial data and reports. While much progress has been made, much more remains to be done. Our plan is to move even more aggressively into in-depth analyses of NASA programs. I believe that, in this way, the OIG can become a full partner in improving NASA's diverse missions.

Mr. CONYERS. You are a tough act to follow. You only threw me off in one place. You said that much progress has been made. Are you kidding me?

Mr. COLVIN. Well, I guess it goes back to how you go about progress.

Mr. CONYERS. Are you trying to encourage them to be good people and repent from their errant ways and you want to say that you said something good about them at this hearing or do you really mean that?

Mr. COLVIN. No, sir, I really mean that. I think there is progress under way. I am not convinced at this point that it is the right progress, I am not convinced that it is going to be efficient or economical progress, but at least progress is being made. I will be back into those same areas to review the commitments that they have made to me to correct those situations.

Mr. CONYERS. You and Jesse Jackson. Keep hope alive, right? Never give up.

Mr. COLVIN. You can't give up.

Mr. CONYERS. I have got some other solutions, but right now I would like to recognize Mrs. Maloney.

Mrs. MALONEY. I find your testimony almost unbelievable, an agency that cannot even appoint a chief financial officer with many of its contractors over budget, behind schedule, and not even producing what they are supposed to produce.

One item caught my attention, and that is the government-owned property that contractors are holding. You testified that contractors hold more than $13 billion in government-owned property; isn't this unusual? Usually contractors receive the funding and then they buy their own typewriter or whatever to do the work. Why is NASA giving government-owned property to contractors? Then you stated that there was no—they couldn't even distinguish between what was government owned and what they were buying with their own funds. Is this a common practice; that an agency gives government-owned property to contractors?

Mr. COLVIN. I wouldn't characterize it as giving it to the contractors, but certainly it is not uncommon for a contractor to be using government-owned equipment in their facility, but you are very correct, Mrs. Maloney, I am extremely concerned about the accountability for the equipment that is under the contractor's purview.

Mrs. MALONEY. Your study showed that they were not able to distinguish between government owned and contractor-owned property. I just know from New York City—I am a freshman—when we contract with contractors, they buy their own equipment, and in all of the hearings that we have had before this committee, contractors do not obtain government-owned equipment. For the first recommendation, Mr. Chairman, I think we should pass a law or at least a recommendation to NASA that we stop providing computers, office furniture and other equipment to contractors. Maybe that is one of the reasons why the $20 billion gap in their budget exists.

I would like more clarification. What other agencies give equipment to their contractors? Can you name one?

Mr. CONAHAN. Perhaps I can take a stab at that, Mrs. Maloney. It is government policy to minimize the amount of government-furnished property handed over to contractors, but many agencies really are not complying with that as they should. Other agencies provide property to contractors. The Department of Defense is a very, very large one in that regard, but energy and others do it as well. There are instances where it makes an awful lot of sense for the government to provide property to contractors.

Special tooling is one area, if we have developed such tooling in order to carry out a project. Also in weapons programs, we contract with a specialized contractor to provide a propulsion system and then provide that system to the platform maker. Providing property in these cases makes sense, but the instances that you are talking about, where we provide common items like computers and furniture and fixtures it doesn't make any sense at all. But we have seen it done time and time again. It is a culture that is built up. It is easier to get it to them that way, but we think it should be stopped. I would welcome any action on the part of the Congress to try and cut that back. It is alarming.

Mrs. MALONEY. OK, it is alarming. You said there is $13.4 billion worth of contractor-held property. As you know, later this session the President and Congress will attempt to cut another $10 billion out of the budget for deficit reduction, and we could start with this $13.4 billion right now. How would you suggest that we correct this? Should we pass a law that government does not give government-owned property to contractors or have a—I mean, it doesn't make any sense.

As I said, I have never seen it in a municipal contracting system or in a State contracting system, and I don't see why we should be giving office furniture and computers to contractors. That is usually part of the contract.

Mr. CONAHAN. I quite agree with you. As I say, government policy and government regulation direct agencies to minimize that kind of activity. I testified before this committee about 3 or 4 years ago with respect to property being furnished to contractors of the Department of State who operate around the Beltway. It was the very similar situation.

Mrs. MALONEY. So what do you suggest we do? Should we just ban it altogether since minimizing has turned into $13 billion worth of mistakes in one agency.

Mr. CONAHAN. Some of that $13 billion would be appropriate, but a large part of it with less specialized use would not.

Mrs. MALONEY. Could you get back to us with a list of what is appropriate?

Mr. CONAHAN. Well, in categories, yes, ma'am, I can do that, but I can't give you a listing of everything that is out there with contractors that is or is not appropriate. That would be a monumental task.

Mr. CONYERS. We would do it ourselves, but we need a special subcommittee for NASA.

Mrs. MALONEY. That is the truth, Mr. Chairman.

[The information follows:]

REPORTED VALUE OF NASA PERSONAL PROPERTY HELD BY CONTRACTORS AS OF SEPTEMBER 30, 1992

Equipment category	Value ($ billions)
General purpose equipment, special test equipment, and special tooling[a]	$3.0[b]
Material	1.9
Space hardware	9.4
Total	$ 14.3[b]

[a] GAO focused on this category because it grew by more than 80 percent from 1982 to 1992. This growth was principally in general purpose equipment, which more than doubled in value during this period to almost $2 billion despite the federal acquisition regulation intention to limit such equipment.

[b] These values are understated by at least $0.34 billion because only general purpose equipment valued at $5,000 or more is reported. Also, NASA permits contractors to use large amounts of equipment for which it retains accountability as installation-held equipment.

Mr. CONYERS. We need to add a subcommittee to Government Operations just to monitor an agency that with a $14 billion budget spends $13 billion on procurement. That needs close watching.

Mrs. MALONEY. Ninety percent of their budget is on procurement, according to his testimony, and $13 billion is government-owned property that is held by contractors.

Again, if you could be more specific. We wanted to stop this practice, you keep saying the policy is to minimize it. Obviously, they are not minimizing it when it is a $13 billion mistake according to your testimony. What should we do? Should we just ban it? What should we do to stop continuing to lose money with government-held property going to contractors? This is just one example. I haven't even gotten to the $90 billion in procurement but the $13 billion, how do you stop that?

Mr. CONAHAN. My proposal would be that the agency needs to show that it is more economical to provide the property to contractors than to have the contractors purchase it themselves under the contract.

Mrs. MALONEY. OK. Who would they show that to? In other words, they show that it is more economical. Who do they show it to? Who is the decision person?

Mr. CONAHAN. The contracting officer would have to make that determination before determining that the property should be furnished.

Mrs. MALONEY. Is that a departure from what the procedure is now?

Mr. CONAHAN. Yes.

Mrs. MALONEY. OK, that is an excellent suggestion, and I intend to join the chairman in legislating that. Now, let's get to 90 percent of their budget is in procurement. Did I hear you correctly?

Mr. COLVIN. That is correct.

Mrs. MALONEY. Out of that, I think you said a large portion of it is not competitively bid. Was it 55 percent you said was not competitively bid in the procurement of the—90 percent of their budget which is procurement? Then you said some of them realized a 288 percent profit on their contracts. I would like the government to see some of that profit and not a contractor. We are in hard times. So they are getting 288 percent profit on their contracts, and in one of your reviews you said out of 329 subcontracts, only 47 or 14 percent were awarded competitively. Why is that? Why are they not awarding more contracts competitively? Don't most government studies show that if you have competitive contracting, the price goes down and the taxpayer wins. Why are we not—why such a small percentage—two parts. Why are they making 288 percent profit when on Wall Street if an aggressive stock fund yields 50 percent, you are really doing well, 288 percent is just an outrageous profit. First of all, why is the profit rate so high on these contracts?

Mr. COLVIN. Mrs. Maloney, the profit rate there that ranges from 28 to 288 percent, in my opinion what allows that is a lack of management oversight of those contractors in the costs that are being charged back to NASA on those contracts. That is where we have got to get back to the proper management of those contracts.

Mrs. MALONEY. Wouldn't the self-regulating management of competitively bidding cut the red tape and lower the price dramatically? So my second question is why are they not competitively bidding these contracts?

Mr. COLVIN. The first part of your statement or your question I certainly agree with, I think it should be competitively awarded. That is what I have recommended. The question as to why they are not doing that, I do not know the answer to that, Mrs. Maloney.

Mrs. MALONEY. Do you think that a suggestion like the one that you had earlier on the government-owned property being given to contractors, that they have to do a cost-effective analysis and submit it to the chief contracting officer as to why they are not competitively bidding? Would that be an approach that might work?

Mr. COLVIN. It might work, but you have contracting officers in place.

Mrs. MALONEY. But they are not working. Your own report shows that their oversight is not working. You show 288 percent profit, a very small percentage of anybody ever competitively bidding anything. You have government-owned property slipping out the door to contractors, and they don't know what is the government's and what is the contractor's. This is my favorite in your report, one contractor on the gamma ray observatory received $5 million bonus for cost-effectiveness even though his contract ran over by $40 million, so here you have someone who spends $40 million more than they are supposed to and they get a $5 million bonus for cost-effectiveness. I would say something is very seriously wrong in the oversight system, to say the least. I think we could balance the budget just out of NASA looking at this, I mean really.

Mr. CONYERS. Is that accurate?

Mr. COLVIN. Pardon me, Mr. Chairman?

Mr. CONYERS. Is the statement that she just recited accurate?

Mrs. MALONEY. It was pulled out of the audit report from March 1993, and concludes that the Goddard Space Flight Center gave contractors award fees even though the contractors had tremendous cost overruns. I quote from your report, it is right here.

Mr. CONYERS. Well, can I confirm it from some of the witnesses?

Mr. COLVIN. Which report is that, Mrs. Maloney?

Mrs. MALONEY. It is the audit report, Goddard Space Flight Center, March 29, 1993, final report on audit of award fee determinations, page 11. It gets into where the contractors earn award fees for being cost-effective when they are overrunning their contracts by hundreds of millions of dollars.

Mr. COLVIN. Is that an IG report?

Mrs. MALONEY. Yes, sir.

Mr. COLVIN. Then the statement is accurate.

Mr. CONYERS. Tell you what, let's let you see it and review it and then tell us if it is accurate.

Mrs. MALONEY. At least you are pointing out the problems, I must say. It is just too bad no one is following up on them.

Mr. COLVIN. That is an accurate statement, Mrs. Maloney. The contractor did receive award fees of $5 million in the cost-effectiveness evaluation category on a contract with a projected cost overrun of $39.9 million.

Mrs. MALONEY. How did that happen? I mean, how did that happen? He gets a cost-effectiveness award for $5 million when he has a contract overrun of $39.9 million. I mean, that is crazy.

Mr. COLVIN. That is the same question I asked, Mrs. Maloney, and that is why we did the audit on excessive award fees. We saw these award fees being given out repeatedly on contracts that did not deserve them. That is the reason we pointed that out.

Mrs. MALONEY. I do congratulate you on another contractor, the geostationary operational environmental satellite which overran its original $276 million contract by a mere $500 million. He could have gotten a $3.6 million bonus for cost-effectiveness until you intervened, and I congratulate you on saving us the $3.6 million, but my question to you is why these huge overruns? Here you have an original contract of $276 million with the geostationary operational environmental satellite and they have an overrun of $500 million. How does that work? How does that get approved? Why is that not stopped? What is the problem there and what do you suggest to correct it?

Mr. CONAHAN. Mrs. Maloney, let me take a stab at that. That is not our report, but it resembles many things that we have seen over time.

As I mentioned earlier, we targeted NASA contract management as one of the 17 high risk areas in the Federal Government, and this report [NASA Contract Management, GAO/HR 93–11, December 1992] which we issued recently in December 1992 sets out all of the problems——

Mrs. MALONEY. Excuse me, the chairman was talking to me, I missed what you said. You said procurement was one of the 17 high-risk areas?

Mr. CONAHAN. No, NASA contract management is one of the 17 high risk areas throughout government.

Mrs. MALONEY. What do you mean? High risk for waste? Vulnerable?

Mr. CONAHAN. Vulnerable to fraud, waste, and abuse, yes, ma'am. This report talks about ineffective oversight of contractors, centers not fully complying with procurement requirements and so on and so on. You asked why some of those things happened under the discussion of ineffective oversight of some contractors. The first caption is that technical activities are not properly monitored. NASA is not monitoring its contractors from a technical point of view the way it should.

Mrs. MALONEY. How do you suggest we monitor? I am literally getting sick to my stomach with this testimony and this amount of wasted dollars that you yourself have documented. Why is this continuing? How could we monitor it better so that we don't have these huge overruns so that we don't give awards for overruns? How can we monitor it better? Do you have a contracting officer there? How can we monitor it better? Is the contracting officer not doing his job? What is the problem?

Mr. CONAHAN. In many instances the problem is not a single individual. Rather, it is the contracting organization that is not doing its job.

Mrs. MALONEY. You don't have one person in charge. Is that a problem?

Mr. CONAHAN. There is a person in charge of the overall operation, but that person has responsibility for other people who must look at contractor cost reporting, at the technical activity underway, at compliance with the host of Federal regulations, at the quality being put into the product, and so on. That whole operation is not being done in a very effective way.

Why is it not being done that way? The only thing I can say is that we have an organization in NASA which, as I mentioned earlier, is very decentralized. You have the centers out there not being monitored by headquarters the way they should. With that kind of a culture, with that kind of attitude, there isn't the kind of discipline within the centers themselves that there should be out there.

This agency receives its appropriation annually from the Hill, and there doesn't seem to be much in the way of a penalty coming from up here; programs continue. There is a lot of involvement by the Hill. We heard earlier from the other side over here about one of the programs being designed in committee. There is an awful lot of that activity that takes place; therefore, we see a lot of instability in NASA programs.

One of the reasons for instability in programs is a lack of long-range planning. If these people were able to look down the road for 5 or 8 years or whatever the life of a program is and lock in on what they wanted to do, we could avoid a lot of that. So it is top level planning we have to worry about, coupled with putting discipline in the system, which I don't see there right now. You have hit it right on the nose. How do you correct it? We are trying to bring the situation to the table right here. NASA management has got to direct its attention to this to get it fixed.

Mrs. MALONEY. In defense of Congress, Congress got involved with the space station only because they had given a long-term commitment and nothing seemed to be happening. It seemed to be money wasted, nothing seemed to be happening, so I submit that it is not long-term planning, it has been very well-funded for long-term plans for a very long time. What is the overall budget of NASA?

Mr. CONAHAN. $14.5 billion this year.

Mrs. MALONEY. $14.5 billion. And 90 percent of that is procurement. Is the procurement in any way centralized or computerized—this is the computer age—on who is getting what to do what?

Mr. CONAHAN. That is one of the difficulties over there. Their financial and information management systems are not at a stage which would give you the kind of oversight control that you are looking for. Each center has its own accounting system. They are not all the same when they come into Washington. A lot of manipulation has to be done——

Mrs. MALONEY. Excuse me, sir, why do they have different accounting systems in different areas? Why don't they have uniform accounting systems?

Mr. CONAHAN. The aim is to have a uniform accounting system. They are working on it right now. However, the target date for installing it is something on the order of 1997, I believe, so we are some ways away from that.

Mrs. MALONEY. I guess we should hear from NASA. I appreciate your pointing out many problems with the program. I would like to hear more ideas on solutions. We have a $14.5 billion contracting mess. What are your proposed solutions to clean it up? I for one don't understand why you have to wait until 1997 to have general accounting practices. Every company in the country has general accounting practices. Why can't we just say go to general accounting practices, you are going to be audited next year?

What are your suggestions to better manage $14.5 billion in contracts, mainly contracts with tremendous cost overruns, with tremendous mismanagement that all of you have documented in your reports to us today? What should we do to correct it?

Mr. CONAHAN. The answer that I will give is not going to be very satisfactory to you, I am afraid. I think that the Federal acquisition regulations, together with the agency supplements of those regulations, are pretty good, and if they were complied with we would see some pretty good acquisition and procurement occurring throughout the government. The problem is they are not being complied with and we don't have in place a mechanism to bring about that discipline, and we don't have a mechanism to bring about either punishment or condemnation of those people who are not following the regulations.

Mrs. MALONEY. How much of the $14.5 billion do you estimate is wasted?

Mr. CONAHAN. I am not going to try to quantify that. Not enough is known about what is out there in order to give you specific answer but it is to much.

Mr. CONYERS. Mrs. Maloney, I want to thank you for some very penetrating questions.

Mrs. MALONEY. How would you clean it up?

Mr. CONYERS. Just a minute. I am reclaiming the time. That is not to terminate the conversation between the gentlewoman from New York and the inspector general. The fact of the matter is we need a subcommittee working with professionals to really dig this up. We are doing this among a dozen other investigations, so it is an impossible task. I will bet you if we oversighted every month in a year we would clean up a lot of things, and it may be that this may be the place where we can save this administration more money in the budget than any one other place in the Federal Government.

Mr. CONAHAN. May I make a comment on that, Mr. Chairman? Mrs. Maloney, I quite agree with you. I think periodic oversight of these major programs is long overdue. We don't do the kind of oversight that will bring about a constant attention to these problems, and I would commend this committee if it could bring that about for all these major programs.

Mr. CONYERS. Well, we thank you both very much. If we had administered the oath at the beginning of this discussion, I presumed that you would have readily taken it.

Mr. CONAHAN. I would take it.

Mr. COLVIN. Certainly.

Mr. CONYERS. And none of your comments would have been any different from the ones that you gave?

Mr. COLVIN. No, sir.

Mr. CONAHAN. Correct.

Mr. CONYERS. OK. Thank you very much, both of you.

Our second panel consists of the Associate Deputy Administrator of the National Aeronautics and Space Administration, Mr. Jack Dailey; the Acting Associate Administrator for Procurement, Ms. Deidre Lee; the Associate Administrator for Management Systems, Miss Benita Cooper; and the Comptroller, Mr. Malcolm Peterson.

Welcome ladies and gentlemen. We have your statement, Mr. Deputy Administrator, and it will be incorporated in its entirety into the record. That will leave you to make any comments that you wish to in describing your statement. I would also invite you to feel free to make any comments about any discussion that has occurred here in the committee prior to you assuming the witness table.

STATEMENT OF JOHN R. DAILEY, ACTING DEPUTY ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, ACCOMPANIED BY DEIDRE A. LEE, ASSOCIATE ADMINISTRATOR FOR PROCUREMENT; BENITA A. COOPER, ASSOCIATE ADMINISTRATOR FOR MANAGEMENT SYSTEMS AND FACILITIES; AND MALCOLM L. PETERSON, ACTING COMPTROLLER

Mr. DAILEY. Thank you, Mr. Chairman, and members of the subcommittee. In lieu of making an opening statement, sir, I would just like to start by commenting on what has gone on so far this morning.

Mr. CONYERS. Please do.

Mr. DAILEY. We are privileged to be here this morning to help clarify the situation at NASA and to, I hope, alleviate some of your concerns, particularly in regard to what we are doing to try to correct these situations. There have been some serious allegations made here that we do not disagree with, and I think that it is important to recognize that this is a situation that faced Daniel Goldin when he reported to NASA about 1½ years ago and set about on a series of programs to get the discipline and the structure into place so that we could correct the deficiencies that have been highlighted here this morning.

I believe that we have made progress, and I was pleased to hear Mr. Colvin confirm that in his comments. Also the comments that both he and Mr. Conahan made in regard to the cooperative nature in which NASA has been working with both the IG and GAO has benefited us significantly, us being NASA in this case.

Many of the investigations that Mr. Colvin mentioned that are under way have been instigated at our request because we had asked for assistance in determining the actual status of a particular program.

Mr. CONYERS. About half of it?

Mr. DAILEY. I don't know. I could provide that for the record, if I may, sir, but I have a feeling that it is probably close to that number.

[The information follows:]

Audits.—For fiscal years 1990–1993, 26 audits were requested by NASA managers and 18 have either been accomplished or are in the process of being accomplished.

Investigations.—For fiscal years 1989–1993, 556 of 1,753 investigations were opened based on requests from NASA management and employees.

Mr. DAILEY. The situation on the government equipment provided to contractors is, in fact, a unique situation with NASA. Of the $13 billion that is in the hands of contractors, about $10 billion of it is space hardware. As mentioned by Mrs. Maloney, 90 percent of our funding is actually for contracts which are not necessarily hardware but are people, and services. We have contractors who actually operate our space equipment, and in this case, as Mr. Conahan pointed out, it is a lower cost alternative for us to provide space shuttles to a contractor to operate rather than have the contractor build a space shuttle to operate for us, that is an extreme example.

There are situations that have been highlighted in the report, the fact that we have provided computers and other common type equipment that would not necessarily be appropriate—we have taken actions to try to correct that situation.

In terms of the management reforms that we have instituted. The major concern that we have had since Mr. Goldin has been the Administrator is to get control of our contracting procedures and our financial management. As we mentioned already, they are identified as material weaknesses and we are pursuing corrective actions with a great deal of energy.

One of the most important things that we have done, and if I may go back to Mr. Conahan's comment about the fact that we had no strategic plan in place but that we have one in work, and that is a very true statement, and it is being done with a very high level of attention. It is under the direction of the Administrator and includes the senior leadership of the agency. We will have that strategic plan in place to be used for the development of our 1996 budget, so early next year we will have a strategic plan—a very important deficiency to be corrected and one that we have recognized. The absence of this plan has caused us some difficulties in coming to grips with the correction and the focus that we wanted to bring in terms of how we were going to correct deficiencies.

In the contract area, Mr. Goldin has instituted a Program Management Council which is chaired by the Deputy Administrator and includes the senior leadership of the headquarters. It has the task of reviewing programs from their very beginning, and this is something that has not been done in NASA previously.

What this means is that before we come up with a program to Congress and ask for funding as a new start, we are going to validate that the technology is within reason. When I say that, I mean it is NASA's purpose in life to pursue the leading edge of technology, and there is risk involved any time we try something because you don't always know what you are going to get when you get there because it is research, but within reason—there are certain things that we do just for research purposes but others where we intend to produce a system. We need to know that we are going to be able to reasonably achieve our goal. That the costing associated with this endeavor is fully identified and that by that I mean all of the costs associated with getting whatever it is into space or flying it or whatever we are going to do, and then to have a mon-

itoring system that follows this program throughout its entire life within NASA.

The council is in place and has begun its work with a special committee now, a different panel going through an independent assessment and analysis to base line the programs so that becomes the foundation from which the Program Management Council will conduct its business. We believe that it is important that this level of discipline is being entered into the system at the agency level, and it is important that I say it that way because we have had this type of oversight and management at the center and even at the Associate Administrator level, but we have not had it focused directly at the administrator's level prior to this time. We believe that this is going to be a significant step and provide better discipline to significantly improve our future performance.

All of the testimony that has gone forth this morning is of course historical, we are fully aware of it and are as concerned as the committee. We know that it is our responsibility as the leadership of NASA to correct it. It is our responsibility to the American people that we get our money's worth for our dollars, and we are dedicated to that purpose. Thank you, sir.

[The prepared statement of Mr. Dailey follows:]

Hold for Release Until
Presented by Witness

National Aeronautics and
Space Administration

October 6, 1993

Subcommittee on Legislation and National Security

Committee on Government Operations

U.S. House of Representatives

Statement by:
Gen. John R. Dailey (Ret.)
Acting Deputy Administrator

HOLD FOR RELEASE UNTIL
PRESENTED BY WITNESS
OCTOBER 6, 1993

Statement of
General John R. Dailey
Acting Deputy Administrator
National Aeronautics and Space Administration

before the
Subcommittee on Legislation and National Security
Committee on Government Operations
United States House of Representatives

Mr. Chairman and Members of the Subcommittee:

Thank you for the opportunity to come before you today to discuss NASA's commitment to improving its management practices.

In this era of fiscal austerity and the attendant emphasis on maximizing the return on investment of each federal dollar, NASA must make a concerted effort to streamline and improve the Agency's management practices. Over a year ago, NASA began an intensive internal Agency review involving "Red and Blue" teams and institutional teams to examine NASA's key programs and the manner in which NASA conducts its business.

A number of management and procurement reforms have been initiated since then, and my associates and I have come today to discuss these reforms and the strides NASA is making in improving the Agency's performance. The efforts we have underway reveal the same conceptual common sense approach as the National Performance Review, and will be reflected in it.

The remainder of my testimony addresses efforts NASA has made to improve the Agency's management by way of examining several specific areas outlined in your invitation letter.

DEVELOPMENT OF A STRATEGIC PLAN WITH REALISTIC BUDGETS:

NASA is currently in the process of developing a strategic plan that will provide an over-arching framework to guide key decisions such as budget, roles and missions, and organization. This effort is proceeding under my guidance.

NASA senior management (including all Headquarters Associate Administrators and Center Directors) is intensely involved in the formulation of the strategic plan by way of a set of working groups and a series of retreats aimed at addressing key issues and building consensus through teamwork.

As a first step in the development of the strategic plan, NASA has drafted vision and mission statements for the Agency and has begun the process of clarifying the identity of our customers and understanding their needs. We have also begun the process of characterizing the Agency's values and operating principles. And NASA has identified and begun to elaborate the separate "strategic enterprises" which comprise our main endeavors and align with our external customers.

NASA expects the first edition of our strategic plan to be in final draft by March 1994. The plan would then be updated and revalidated in the beginning of each year, so as to synchronize with the budget preparation process.

PROGRAM/PROJECT MANAGEMENT (PPM) REFORM:

In October 1992, the NASA Administrator chartered a Program Excellence Team (PET) as a part of his agency-wide continual improvement initiative in program management. The objectives of this activity are to reduce the cost and time NASA requires in our major development programs and to improve our ability to meet our commitments. The PET was tasked to strengthen and streamline the policies and processes governing management of NASA's major system development projects, and to develop a single, comprehensive policy document combining the agency's program and acquisition management procedures. The team developed and presented to both Agency senior management and the NASA Program/Project Management (PPM) community a proposal for major revisions to current PPM policies and processes. The new program management policy builds on the strategic planning thrust to ensure that NASA only expends resources on high priority projects and that NASA thoroughly understands all requirements and associated risks before proposing them to Congress for approval. We have established a Program Management Council (PMC), chaired by the Deputy Administrator, to assure new start readiness and compatibility with the Agency strategic plan. In addition, we have extended the project definition effort through preliminary design and established a formal commitment process for deliverables, schedule and content. Visibility and accountability will be significantly improved through implementation of this policy.

COMPLIANCE WITH THE FEDERAL MANAGERS FINANCIAL INTEGRITY ACT:

NASA has an Internal Management Control Program which complies with the Federal Managers' Financial Integrity Act (FMFIA) and OMB Circular A-123. In response to OMB budget direction and a recommendation by NASA's Office of Inspector General, NASA upgraded its Management Control staff and established an audit follow-up procedure. A Management Control Review was conducted at each NASA Installation and a judgement sample of audit recommendation closures was reviewed to verify that corrective action had been taken.

In NASA's FY 1992 FMFIA report to the President and Congress, the Agency reported 2 high risk areas, 6 material weaknesses, 4 material nonconformances, and 2 areas of significant management concern. The Agency is taking corrective

action on all weaknesses identified and has milestones to ensure that these problems are fully addressed. Subsequent to the FY 1992 report, the Environmental Program, which NASA has identified as a Material Weakness in its FY 1992 report, was designated a High Risk Area.

One of NASA's major concerns is the design and development of its accounting and financial management system. Present plans call for full implementation of the NASA Accounting and Financial Information System (NAFIS) by July 1997. In the interim we are continuing to use the financial management system which is in place and based on NASA's accounting principles, standards, and system design approved by the General Accounting Office in 1969. NASA recognizes that the present system has a number of control weaknesses. The Agency has reported and is taking corrective action to improve financial management controls through the identification of four material nonconformances and one material weakness related to its financial management system.

A second area of concern which NASA is aggressively addressing is contract and subcontract oversight. OMB identified this as a high risk area in 1989 and NASA has made many improvements in contract management. Because NASA believes that enough progress has been made, the Agency intends to request that OMB remove this issue from the high risk category, and NASA will continue to pursue improvements of contract management prior to Agency closure as a material weakness.

Another important area is NASA's overall effort to improve the management control review processes at the Agency. A two-year Agency wide development effort, in collaboration with the Inspector General, has resulted in a system of Functional Reviews and Self-Assessments in 18 functional areas that will integrate management control evaluation into the review process. This process empowers line managers to develop strong management systems and controls and holds them accountable for identifying and correcting weaknesses. It makes the management control program at NASA an integral part of Agency management rather than a separate program.

NASA recognizes that management control is inherent to all managers' responsibilities. In a complex activity that must rely heavily on contracts, there are, and will continue to be, serious management control issues that must be identified and addressed. NASA is fully committed to this responsibility. At the same time, we recognize that management controls must be reasonable and cost effective.

Finally, to be fully responsive to an OMB initiative to revise OMB Circular A-123, which provides guidelines for Federal Agency Management Control Programs, NASA established a Task Team to develop recommendations to our Internal Control Manager (Associate Administrator for Management Systems and Facilities) for revising NASA's Management Control Program. NASA expects to be ready to meet new directions in complying with the FMFIA, upon release of revised OMB guidelines.

NASA's MANAGEMENT OF GOVERNMENT-OWNED PROPERTY PROVIDED TO CONTRACTORS:

NASA's Government-owned personal property provided to its contractors in performance of the Agency's contracts is estimated to be ove: $18 billion for Fiscal Year 1993 under 1,000 contracts. This property is predominately space hardware, special test equipment, and special tooling, but also includes general purpose equipment and materials. The vast majority of NASA contracts are delegated to DoD for property administration.

Contractors provide to NASA an annual summary property financial report. DoD/NASA test the adequacy of the control systems annually or biannually on a statistically valid sampling basis. Where DoD has been delegated property administration, NASA does not duplicate DoD's efforts, but accepts their reports of system status.

GAO issued a report in October 1992 which included a number of findings related to management of contract property. The primary finding was that NASA's property financial reports were not timely or accurate and systems surveys were not timely. These findings were also included in the GAO High Risk Series NASA Contract Management Report in December 1992.

NASA has taken a number of aggressive actions in an effort to address the problems cited by GAO, including: declaring a material weakness related to property financial reporting and system survey reporting; development of a corrective action plan which is being actively pursued by Headquarters and the NASA Centers; and, establishment of performance measures for Center reporting on receipt of property financial reports and systems surveys.

In addition, NASA has worked extensively with both the Defense Contract Management Command and the Office of Naval Research at both Headquarters and field level to improve communications and the level of DoD support under NASA delegation.

Although the Contract Property Material Weakness remains open and corrective actions are continuing, it is anticipated that corrective actions will be completed in 1994.

ISSUES ASSOCIATED WITH THE LATEST REDESIGN OF SPACE STATION:

Last June, President Clinton directed NASA to redesign the Space Station in order to reduce cost while retaining user capability and maintaining the program's international commitments. NASA has scaled down and simplified the Space Station design, reduced its operational complexity, and streamlined its management structure. These changes reduce costs while preserving NASA's ability to conduct critical space science research central to accomplishing the mission of the Space Station.

On September 7, 1993, NASA took an important step in executing the President's directive when it completed the Space Station Program Implementation Plan. This plan, requested by the President on June 24, 1993, provides better definition of the modular Option A design that was presented on June 10, 1993, by the Advisory Committee on the Redesign of the Space Station (the Vest Committee). Following the President's direction, the design described in this plan incorporates appropriate enhancements to the original Option A design. The enhancements were made to increase capabilities for our users, and to improve the maintainability of the station with minimal increase in cost.

The President established a funding level of $2.1 billion a year for the Space Station for FY 94-98. Based on this funding profile, the Space Station assumes First Element Launch in September 1998 and the achievement of Permanent Human Capability in September 2003.

NASA has reduced the long-term costs of the program with the use of a revised operations philosophy that will cut the Space Station operating costs by nearly 50%. This new approach includes a stronger emphasis on autonomous operations and reduction in the size of control center staffs and supporting engineering personnel. The Space Shuttle and Space Station programs will share facilities, tools, services and personnel.

Perhaps most important, NASA has streamlined the Space Station management structure by establishing a single core program office, eliminating one level of management and significantly reducing civil service and contractor staff.

In its effort to reduce bureaucracy and increase efficiency, NASA will reduce the size of its Space Station civil service work force from 2,300 to approximately 1,000. NASA expects its contractors to make reductions in line with the new funding profile as well.

The first steps NASA took to streamline the Space Station's management were to name Johnson Space Center as the Space Station Host Center and Boeing as the single prime contractor. These moves are consistent with recommendations made by the Vest Committee. The Vest Committee noted in its report that "a streamlined organization will produce significant program savings and perhaps more importantly, a flexible organization capable of firm, high quality and expeditious decision making with clear lines of authority and responsibility."

A new management structure is being put in place that relies on a line organization which reports directly to the Space Station Program Manager. This organization eliminates duplication of effort across NASA centers by incorporating a product-oriented team structure. Each Space Station "product" will be managed by a team of government and contractor personnel responsible for its success.

These teams are called Integrated Product Teams (IPTs) and are based on successful military and commercial programs. They are multidisciplinary and are responsible and accountable for a budget, a schedule, and a technical area of responsibility. The IPT approach has been shown to shorten decision loops, focus activity on products, reduce re-work, save time and money, and improve

accountability. To help ensure the teams remain on schedule and within cost, a Program Control office will support the teams and conduct program-wide assignments of costs and schedule. In addition, the Space Station program procurement organization will report directly to the Program Manager. The single prime contractor for Space Station will centralize accountability and responsibility for program hardware integration.

The NASA program management philosophy for the redesigned Space Station is simple, efficient, product-focused, and based on a clear allocation of responsibility. The organizational structure and management processes are designed to keep decision loops short and to relate and balance the technical, cost, and schedule aspects of using multi-disciplinary product teams. These approaches create an economical, goal-oriented climate to get the job done.

That concludes my opening statement. I would be happy to address any further questions you or the other Members of the Subcommittee may have.

Mr. CONYERS. Well, now that you have pled guilty, are you ready for your sentence to be pronounced upon you?

Mr. DAILEY. I am, sir.

Mr. CONYERS. Well, if I were able I would create a new subcommittee in Government Operations that would specifically focus its responsibilities entirely upon NASA to make sure that your good intentions are adhered to.

Now, I have only been in government a few decades, so of course I believe you entirely, that this is going to be a new program with a new day, a new start, but I would set up the subcommittee anyway, and we would proceed to help you accomplish the goals that we all agree upon. Since I don't have the unilateral ability to create a subcommittee, I can assure you, Mr. Dailey, that we are going to begin to take this matter up. This is one of the few matters that my friend and chairman of the Michigan delegation, John Dingell, has not focused in upon. You are very lucky that it is this small minor committee that is investigating you instead of Chairman John Dingell investigating you. Goodness knows where that would have led and when it would have ended, if ever. But we are reasonable people in this committee. We tend to believe witnesses, especially people of your stature in government service, which is significant to me, and so we are going to congratulate you on facilitating this hearing by being courageous enough to concede that these deficiencies are not seriously in contest, and we begin working on them together. So that makes you very reasonable and it makes us very reasonable, too, doesn't it?

You are not quite sure about that? OK. Let me try to convince you that we are as reasonable as I claim you are. You are very reasonable, but we are very reasonable, too because our focus is to oversight the government in its entirety in terms of efficiency and effectiveness in the expenditure of Federal funds. We are only doing our job. Unfortunately, we couldn't have gotten to you any sooner. There are long lists of agencies and departments that are screaming for our oversight, literally.

But do you know that today is, to the date, the third year that this committee passed out the Chief Financial Officers Act? It was on October 6, 1990, that we passed out the report. If I gave you a copy of the Chief Financial Officer Act of 1990, would it help move your organization to appoint a chief financial officer as prescribed by the Federal laws of the United States?

Mr. DAILEY. I have read that act, sir, and it would not be necessary for you to give it to us to have that happen. The difficulties that we have experienced in this area I believe have been compounded by timing perhaps of changing of Administrators and changing of administrations and the delays associated with political appointments and confirmations. We are actively pursuing the assignment of a chief financial officer to NASA. We are eagerly awaiting the individual's arrival, and anything this committee could do to help us achieve that goal would be greatly appreciated.

Mr. CONYERS. Well, I want to offer the full scope of our services to help you achieve that goal. Could you estimate whether in calendar year 1993 you will have achieved that goal? Or would it take longer than that?

Mr. DAILEY. I hope that that is the case, sir. We are getting serious attention from the administration in filling this position. We have candidates who have been interviewed and nominated for the position. It is in the process.

Mr. CONYERS. If I went to the President of the United States about this matter, would that help you in any way?

Mr. DAILEY. I am not sure. It could be more help than we need at the moment, sir. I would like to request that we let the process work, we have just received a White House liaison person in our Administrator's office who is working this single issue, and I will report personally any progress and keep you informed as to how we are doing. Should it become beneficial, I would like to request the opportunity to in the future request that support.

Mr. CONYERS. That sounds perfectly reasonable. Let me make another suggestion. Would it help you if I went to the Vice President of the United States who is in charge of the committee popularly known as "Reinventing Government" to give you some assistance in this prodigious effort of finding and nominating and getting in place a chief financial officer for NASA? Could that serve a useful purpose?

Mr. DAILEY. Yes, sir, I think it might.

Mr. CONYERS. I will be delighted to bring it to his attention. Would you agree that I could bring it to his attention as soon as today?

Mr. DAILEY. Yes, sir.

Mr. CONYERS. All right. And then may I get back to you on his response about this discussion?

Mr. DAILEY. I would appreciate that very much.

Mr. CONYERS. He probably will get back to you.

Mr. DAILEY. I am anticipating that also.

Mr. CONYERS. Well, that is wonderful.

Are there any other matters that you or the persons at the witness table would like to bring to our attention before we dismiss you?

Mr. DAILEY. I would like to just reaffirm, sir, the dedication that I and all of the team members in NASA have to correcting these situations. The fact that you are concerned about not having an oversight committee that can be completely dedicated to NASA, I hope we can alleviate—I hope that the next time we meet that you are comfortable that what we have told you we are going to do is being done and that what we are doing is correcting the problem because we are going to fix this. We are totally dedicated to it, and I believe a man is only as good as his word, and I am giving you my word that we are going to do this.

Mr. CONYERS. Thank you very much. None of you were put under oath, but if you had been asked to take the witness oath today would you have freely taken it?

Mr. DAILEY. Without reservation.

Mr. CONYERS. Yes. And having not taken it, would all of your statements that you made still remain to be the truth without the oath?

Mr. DAILEY. They would, yes, sir.

Mr. CONYERS. Then thank you very much, Mr. Dailey, and ladies and gentlemen.

Mr. DAILEY. Thank you very much, Mr. Chairman.

Mr. CONYERS. You are welcome.

The next panel is one composed of Ms. Marcia Smith; Professor Howard McCurdy; Mr. John E. Pike, who is the director for space policy project of the Federation of American Scientists. I am going to ask him to lead off.

Professor Howard McCurdy is a professor of public affairs at American University, and Ms. Marcia Smith is the Acting Assistant Chief of Science Policy Research of the Library of Congress, and with her is Mr. David Radzanowski.

Director Pike, could you help us understand the culture inside the government and maybe the agency that is the particular focus of our examination today? What creates the culture that resists change with such tenacity as built up in this record over the years with this one agency? Is there something in the water or is it the air we breathe or is it so many bureaucrats in contact with each other bouncing around like molecules? What is happening? Why can't reasonably dedicated Americans work more efficiently than wasting billions of dollars a year in matters that are literally inexcusable?

STATEMENT OF JOHN E. PIKE, DIRECTOR, SPACE POLICY PROJECT, FEDERATION OF AMERICAN SCIENTISTS

Mr. PIKE. Well, I really wish that I could answer that question but unfortunately I can't or at least I can't answer it to my satisfaction. When I look at what NASA has done over the last three decades or so, it seems to me that year in and year out very persistently NASA projects wind up costing a lot more and taking a lot longer than they were originally projected, and unfortunately NASA, which is where the personnel would be to make such an evaluation, having spent half a trillion dollars over the last generation simply has not reviewed these projects and understood what it is that is necessary to make a project work and what these problems have been.

NASA today simply does not have an accepted definition of what constitutes best practice for program management, and so as a result there are a wide variety of ways that these programs have been managed. Some of them have worked, some of them have not, and we—NASA simply lacks the institutional capability at this point for doing that sort of review.

At the Defense Department, we have the Office of Program Analysis and Evaluation that does this. NASA simply doesn't have that sort of institutional capability. I think to the extent that I am able to understand what the problem is at NASA, it is precisely those lack of central institutional capabilities that I find at the Defense Department.

There are a whole range of central management mechanisms that are in place at the Defense Department, however imperfectly they are working, at least we do have an office, Under Secretary of Defense for Policy, at least we do have a Future Year's Defense Program, at least we do have a Defense Acquisition Board that has established milestones and exit criteria for going to the next stage. By and large, these mechanisms are largely absent at NASA, and I think one of the reasons that they are is that NASA is an institu-

tion which was cobbled together three decades ago out of a number of previously independent institutions.

And as previous witnesses have noted, NASA is an extremely decentralized agency and as a result has extraordinarily weak central control mechanisms for running the agency, and so the reason that I don't know what the problem at NASA is is because NASA doesn't know what the problem is, and there is no one over there who is really in a position to figure it out.

[The prepared statement of Mr. Pike follows:]

F.A.S.

FEDERATION OF AMERICAN SCIENTISTS
307 Massachusetts Avenue, N.E.
Washington, D.C. 20002 (202) 546-3300

Board of Sponsors
(Partial List)
* Sidney Altman
* Philip W. Anderson
* Christian B. Anfinsen
* Kenneth J. Arrow
* Julius Axelrod
* David Baltimore
Lipman Bers
* Hans A. Bethe
* Konrad Bloch
* Norman E. Borlaug
Anne Pitts Carter
* Owen Chamberlain
Abram Chayes
Mildred Cohn
* Leon N. Cooper
Paul B. Cornely
Carl Djerassi
* Renato Dulbecco
John T. Edsall
Paul R. Ehrlich
George Field
* Val L. Fitch
Jerome D. Frank
* D. Carleton Gajdusek
John Kenneth Galbraith
Richard L. Garwin
* Walter Gilbert
Edward L. Ginzton
* Donald A. Glaser
* Sheldon L. Glashow
Marvin L. Goldberger
* Dudley R. Herschbach
* Alfred D. Hershey
William Higinbotham
* Roald Hoffmann
* Robert W. Holley
* Jerome Karle
* H. Gobind Khorana
* Arthur Kornberg
* Polykarp Kusch
* Willis E. Lamb, Jr.
* Leon Lederman
* Wassily W. Leontief
* William N. Lipscomb
Roy Menninger
Robert Merton
Neal E. Miller
Philip Morrison
Richard A. Muller
* Daniel Nathans
* Marshall Nirenberg
* Severo Ochoa
Charles E. Osgood
* Linus Pauling
* Arno A. Penzias
Gerard Piel
Charles C. Price
Mark Ptashne
* Edward M. Purcell
George Rathjens
* Burton Richter
David Riesman, Jr.
Alice M. Rivlin
Carl Sagan
* Arthur Schawlow
* J. Robert Schrieffer
* Julian Schwinger
* Glenn T. Seaborg
Phillip A. Sharp
George A. Silver
* Herbert A. Simon
Alice Kimball Smith
Cyril S. Smith
* Henry Taube
* Howard M. Temin
* James Tobin
* Charles H. Townes
Frank von Hippel
* George Wald
Myron E. Wegman
Robert A. Weinberg
Victor F. Weisskopf
Jerome B. Wiesner
Robert R. Wilson
C. S. Wu
Alfred Yankauer
Herbert F. York

* Nobel laureates

*Robert M. Solow
Chairman

Richard L. Garwin
Vice-Chairman

Ann Druyan
Secretary

Carl Kaysen
Treasurer

Jeremy J. Stone
President

NASA
Challenges to Post-Cold War Performance and Management

Testimony
before the
House Government Operations Committee
Legislation & National Security
Subcommittee

6 October 1993

John Pike

Director
Space Policy Project
Federation of American Scientists

National Council Members

Barry M. Casper
Stephen F. Cohen
Denis Hayes
Gerald J. Holton
Thomas L. Neff
George W. Rathjens
Barbara Hatch Rosenberg
Arthur H. Rosenfeld
Lawrence Scheinman
Martin J. Sherwin
J. David Singer
Valerie Thomas

Ex Officio John Holdren, Matthew S. Meselson

Facsimile (202) 675-1010 Telex: 9102509251 FAS DC UQ

JOHN E. PIKE

John Pike, Director of the Space Policy Project at the Federation of American Scientists, coordinates research, analysis and advocacy on military and civilian space policy. A former political consultant and science writer, he is the author of over 170 studies and articles on space and national security, and co-author of the book **The Impact of US and Soviet Ballistic Missile Defense Programs on the ABM Treaty.**

In 1986 the National Journal named Pike as one of the 150 "People Who Make a Difference" in Washington. In 1988 U.S. News and World Report, citing his work on space and defense, listed him among the 250 members of the "New American Establishment." And in 1991 he received the Public Service Award of the Federation of American Scientists.

He advised the 1984 Mondale campaign, the 1988 Dukakis campaign, and the 1992 Clinton campaign on defense and space policy issues. As the most visible critic of the Strategic Defense Initiative, he is frequently called on by print and broadcast media for commentary, and by Congressional Committees for testimony, on space and national security issues.

In 1991 he participated in the NASA International Near-Earth Object Detection Panel. He has served as a Technical Consultant to the United Nations Group of Government Experts on Confidence Building Measures in Outer Space, as well as to other government and corporate clients, including Cable News Network, National Public Radio, Universal Studios and the British Broadcasting Corporation.

In June of 1983 Pike initiated the Space Policy Working Group, a weekly meeting of public interest and Congressional staff working on space and national security, and chaired the group through December 1984. He was active in the formation of the National Campaign to Save the ABM Treaty, and served on its Executive Committee. He currently serves on the Scientific Advisory Board of the Peace Research and European Security Studies Center and the Advisory Board of the Verification Technology Information Center of London. He is also a member of the Council on Foreign Relations, the American Institute of Aeronautics and Astronautics, the American Astronautical Society, the Air Force Association and the U.S. Naval Institute.

The Federation of American Scientists is a non-profit organization of 4,000 natural and social scientists and engineers, including half of America's living Nobel Laureates. Concerned with problems of science and society, FAS was founded in 1945 as the Federation of Atomic Scientists by scientists who had worked on the Manhattan Project.

NASA
Performance and Management

John Pike
Federation of American Scientists

The American space program has recently suffered a series of setbacks recalling the aftermath of the Challenger accident, and the initial humiliations of Sputnik and Gagarin. The loss of the Mars Observer and a NOAA weather satellite, unsuccessful attempts to launch the Space Shuttle, the failure of a Titan rocket carrying a billion dollar spy satellite, and the near cancellation of the Space Station program – all have called into question America's future in space.

These woes come on the heels of other problems. Inadequate testing of the mirror of the Hubble Space Telescope has impaired the utility of this multi-billion dollar instrument, necessitating a challenging repair mission. For much of 1990 the Space Shuttle fleet was grounded, pending resolution of leaky fuel lines. The Galileo planetary spacecraft remains crippled by a malfunctioning antenna. Design problems with the GOES weather satellites threatened to leave America's weather service in peril.

It would be comforting to believe that this recent string of setbacks and disappointments is merely the result of technical incompetence or mismanagement. In that case, the task at hand would simply consist of firing the incompetents and reorganizing a few agencies, and everything would be put right. Unfortunately, this is not the case. That every aspect of America's space effort, military and civilian, piloted and robotic, should have come to grief within the space of a few weeks, demonstrates rather that there is no easy road into space. Just as there is no magic formula for success, there is no easy recipe for avoiding

disaster.

After the launch of Sputnik and the flight of Gagarin, there was little question that America would respond. Similarly, after the deaths of the Apollo astronauts in 1967, and the deaths of the Challenger crew in 1986, there was no question as to whether Americans would again fly into space. In each case, the ultimate answer was the same. As long as the Soviet Union continued its efforts in space, the United States would also continue to push back the space frontier.

But today, the Soviet Union no longer exists, the Cold War has ended, and the space race is over. Now America, along with the other space-faring nations, must decide whether the exploration and development of the space frontier will become a defining activity of the new world order, or whether the Space Age was merely a peculiar expression of the Cold War which, along with inflated nuclear arsenals, can now happily be dispensed with. We must now decide whether spacecraft will become the hallmarks of the 21st century, as aircraft were of the 20th century, or whether spacecraft will be grouped with Zeppelins as technological curiosities of no lasting significance.

If the truth be known, this recent string of problems is no more than coincidence, with separate programs running into bad luck at the same time. Just as no investor can consistently beat the stock market, no space program can consistently count on only good luck.

But the misfortunes of these individual projects is the good fortune of America. It is only in crisis that the fundamentals of national policies and institutions can be reexamined. We are fortunate that this crisis in our space effort has come at a time when our national space policy, and the agencies which implement it, are in dire need of reappraisal. NASA as an organization is clearly unprepared for the challenges of the post-Cold War era.

1 - NASA's Track Record

It would be comforting to believe that NASA's problems are simply the result of incompetent managers or engineers who could be fired, or misguided policies that could be changed, or inept bureaucracies that could be reorganized. However, it may be that the sobering truth is that these problems are normal obstacles on the steep road into space. A review of past program performance suggests that today's problems are but the latest instances of SNAFU - situation normal, all fouled up. NASA is not uniquely vulnerable to Murphy's Law - if it can go wrong, it will go wrong. It is an abiding fact in the space business that despite best efforts, seemingly silly mistakes continue to occur. This is true for military and commercial projects as well as NASA, and for European, Russian and other nation's efforts.

A - The Good Old Days

We tend to compare present difficulties with past successes rather than past problems. The achievements of the space program are impressive precisely because of the risk, and reality, of failure. The recent string of problems is frequently contrasted to the "Good Old Days" of the space program, the supposed golden age in which our rockets flew straight and our satellites always worked. The cost overruns and schedule delays of today are held to be an aberration from a previously established norm of managerial excellence in which projects were completed on time and under budget.

It would be surprising if the NASA of three decades ago was not regarded as a departed Golden Age. With the buildup of Apollo in the early 1960s, NASA's budget and staff grew by leaps and bounds. Under such conditions of rapid expansion, funding was plentiful and bureaucratic supervision minimal. Who would not express nostalgia for a departed era of

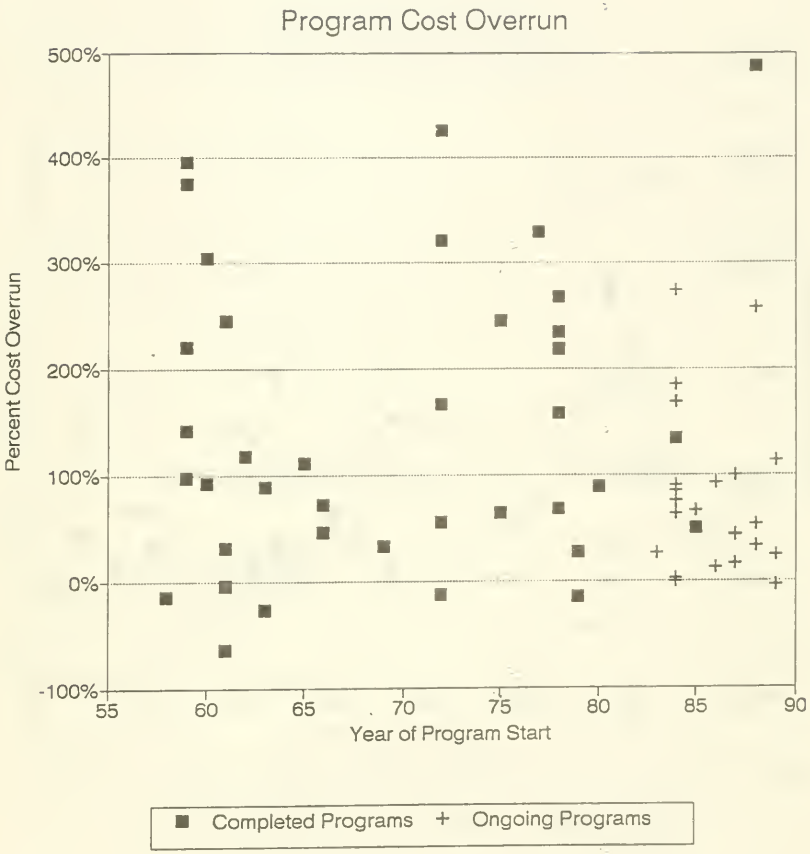
abundant funding and the freedom that goes with building a rapidly expanding institution? But these extraordinary conditions soon ended, as did NASA's brief Golden Age.

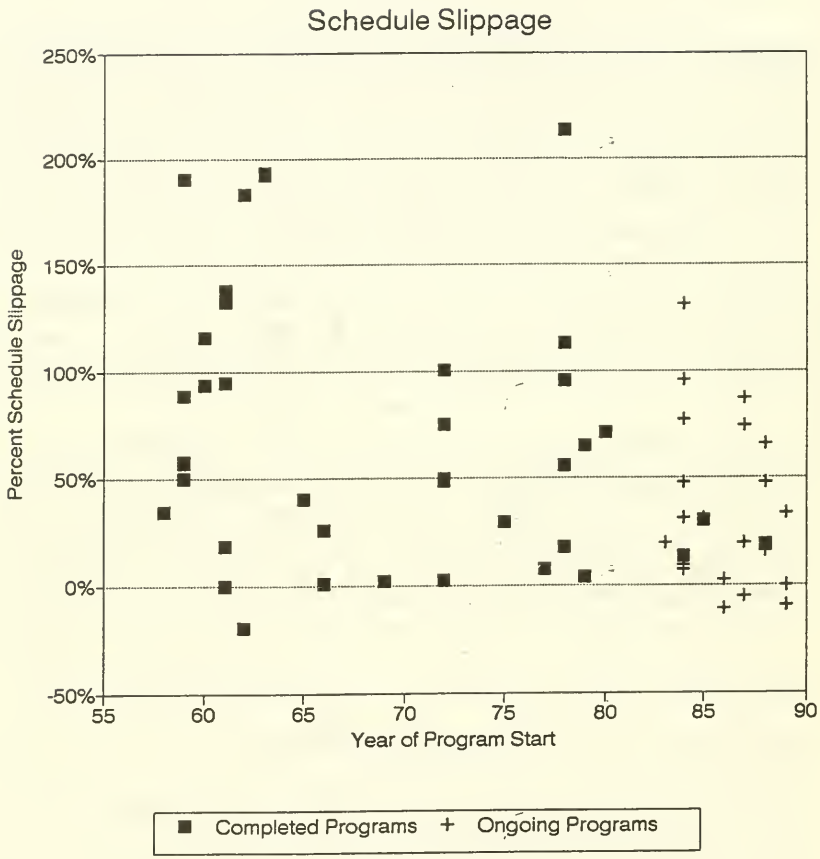
Perhaps the challenge of competition encouraged a superior style of work, with NASA personnel putting in the extra effort and hours needed to win the race to the Moon. Shock labor work habits are the hall-mark of the Tiger Teams and Skunk Works that reputedly spawn superior aerospace products. Today at NASA facilities the rule seems to be a much more relaxed and placid style of work. But possibly it is too much to expect the personnel of any government agency, even NASA, to remain in a state of perpetual frenzy.

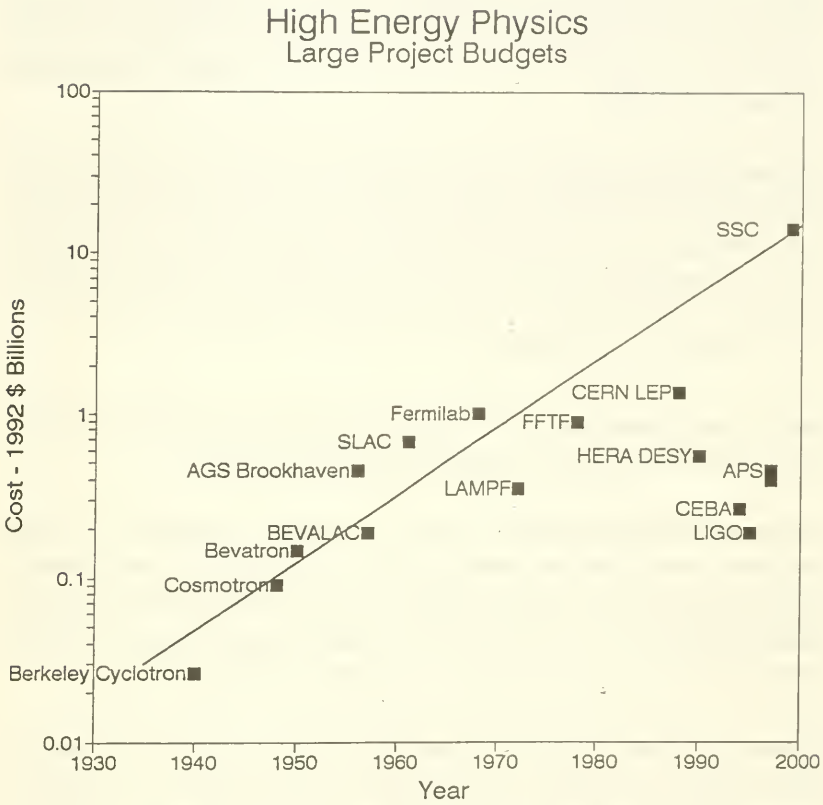
Although the NASA of the early Apollo Era may have been a more enjoyable and stimulating work environment than today's NASA, there is little evidence to support the proposition that today's NASA is but a pale reflection of former glory.

Neil Armstrong and Buzz Aldrin standing by the American flag on the Moon was the high point of a deeply troubled program, which experienced major technical and quality control failures. Apollo killed three astronauts in 1967 and nearly killed three more on Apollo 13, was over two years behind its original schedule and substantially over early budget estimates, and flew only half of the missions originally contemplated. Having barely overcome major engineering problems in the mid-1960s, America did not win the race to the Moon – Russia lost it.

More generally, over the past three decades, major space projects have consistently taken about 60% longer to complete than originally planned, and have required over 130% more money than initially projected. Indeed, the heroic cost overruns of the 1960s, when programs frequently wound up costing four or five times the original budget, make current budget problems seem rather tame. There is no apparent trend suggesting some recent institutional decay of NASA's technical or management capabilities.


Program Cost Overrun
500%
400%
300%
200%
100%
0%
-100%
Percent Cost Overrun
55
60
65
70
75
80
85
90
Year of Program Start
Completed Programs
Ongoing Programs


Schedule Slippage
250%
200%
150%
100%
50%
0%
-50%
Percent Schedule Slippage
55
60
65
70
75
80
85
90
Year of Program Start
Completed Programs
Ongoing Programs


High Energy Physics
Large Project Budgets
Cost - 1992 $ Billions
100
10
1
0.1
0.01
1930
1940
1950
1960
1970
1980
1990
2000
Year
SSC
CERN LEP
Fermilab
FFTF
SLAC
HERA DESY
APS
AGS Brookhaven
LAMPF
CEBA
LIGO
BEVALAC
Bevatron
Cosmotron
Berkeley Cyclotron

B - Is Small Beautiful?

For the past several centuries, the progress of science and technology has been well characterized by Isaac Newton's remark that "if I have seen far, it is because I have stood on the shoulders of giants." Today, standing on the shoulder of giants, we are bumping our heads against the ceiling.

After more than a third of a century of space exploration, the easy things have been done. Just as Isaac Newton could discover gravity with little more than an apple tree, in the early days of the space age, fundamental discoveries could be accomplished with relatively simple and inexpensive spacecraft. But today, ever more complex and expensive spacecraft are needed for further advances on the final frontier. A similar trend is evident in the history of high energy physics facilities.

America's space program of today is no more prone to failure than in the past. However, today's mistakes and accidents are inevitably more costly and painful.

The problems with Hubble have been given such high visibility because they strike at the heart of the current debate over funding for big science projects. In the past, scientific research was conducted by individual researchers, or occasionally by teams of scientists using facilities that cost at most a few hundred million dollars. Decisions on funding priorities for such research were generally made by the scientific community alone.

But today, a wide range of scientists contend that the progress of science requires facilities costing billions or tens of billions of dollars, which is real money even by Washington standards. The unprecedented cost of these facilities has rendered them too important to be left to the scientists. Advocates of these mega-science projects appeal not simply to their scientific value, but increasingly to commercial and cultural benefits to the tax-paying

public. Few can deny that the robotic spacecraft that explored the planets over the past three decades more than paid for themselves with the pretty pictures of new and exotic landscapes and cloudscapes. The "Hubble Hype" promised to continue this tradition, with pictures of the heavens ten times clearer than from the ground, extending back to the beginning of the universe.

With savage irony, the defects in Hubble's mirror affected the two cameras that were to have to produced the pretty pictures for the public, while leaving the other instruments largely unaffected. Thus Hubble is temporarily out of commission for the taxpayers, while the scientific community's interest is relatively unaffected.

2 - Is There a Better Model?

In recent years some critics of NASA's performance have suggested that there is an alternative model – the Strategic Defense Initiative Organization (SDIO). Proponents of this agenda argue that NASA is an aging and moribund agency that has lost the vigor of its youth, while the SDIO has reincarnated the spirit of the NASA of the 1960s. Thus it is contended, only by transplanting SDIO personnel and attitudes to NASA will it be possible to revive this decaying agency.

However, this construction is predicated on the assumptions that SDIO has been an unusually successful operation, and that lessons from SDI are applicable to NASA. There are grounds for questioning both of these assumptions.

Supporters frequently point to the Delta 180 program, managed by NASA Chief Engineer Mike Griffin (formerly of SDIO), as a model of "cheaper, faster, better." But they fail to note that this space experiment was based entirely on proven hardware obtained from other programs which bore the brunt of the time and expense of their development. And they fail to note the trivial results of this flight. Subsequent space experiments in this series have involved the development of new hardware, and have had development schedules and costs that are similar to those found in other NASA programs.

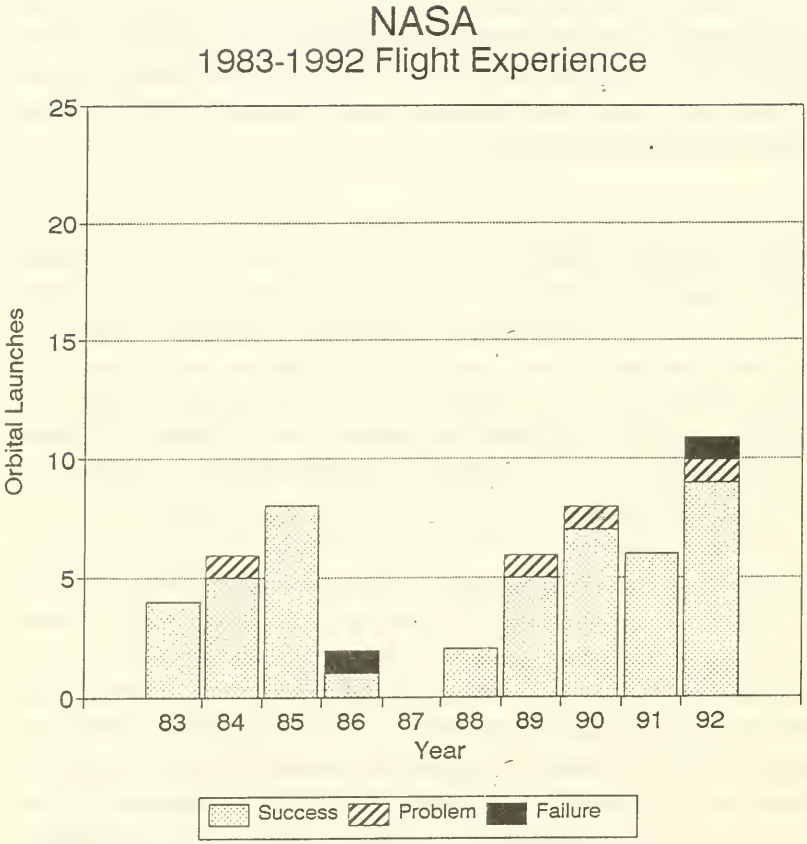
The fundamental contrast between NASA and SDIO is one of risk management philosophy. According to the SDIO view, NASA is unnecessarily cautious – excessively risk averse. While NASA is certainly more risk averse than SDIO, this may be more a matter of necessity than of choice. The SDIO risk management philosophy derives from that of the Department of Energy weapons laboratories. Livermore and Los Alamos have the option of tolerating failure. When a $20 million underground nuclear explosion fails to meet expectations, little is lost and few will notice. When an SDI test fails, only a few million

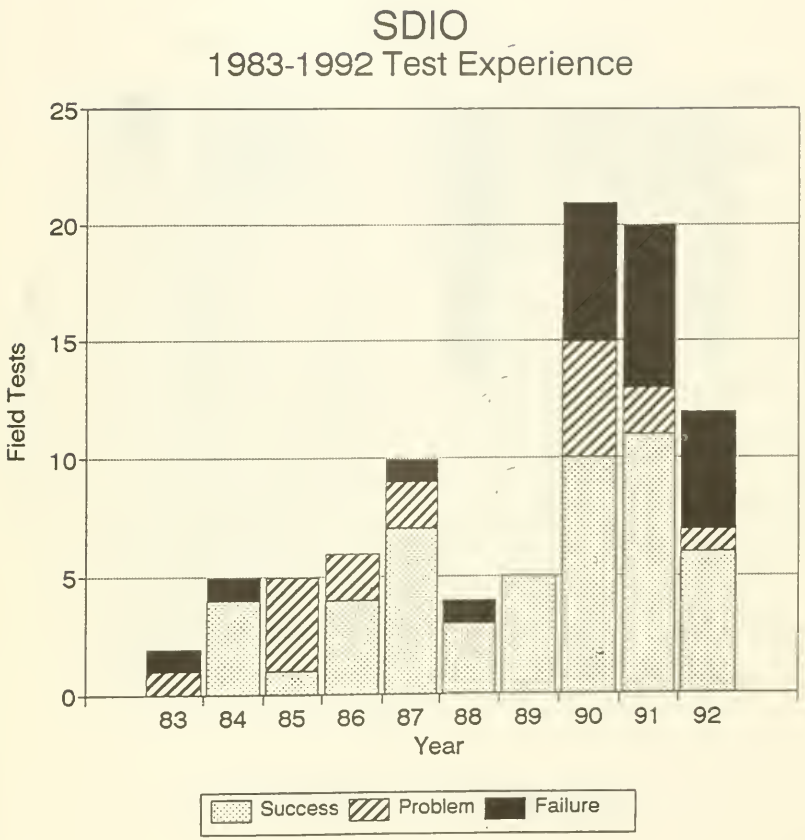
dollars is at stake, and the public is largely unconcerned.

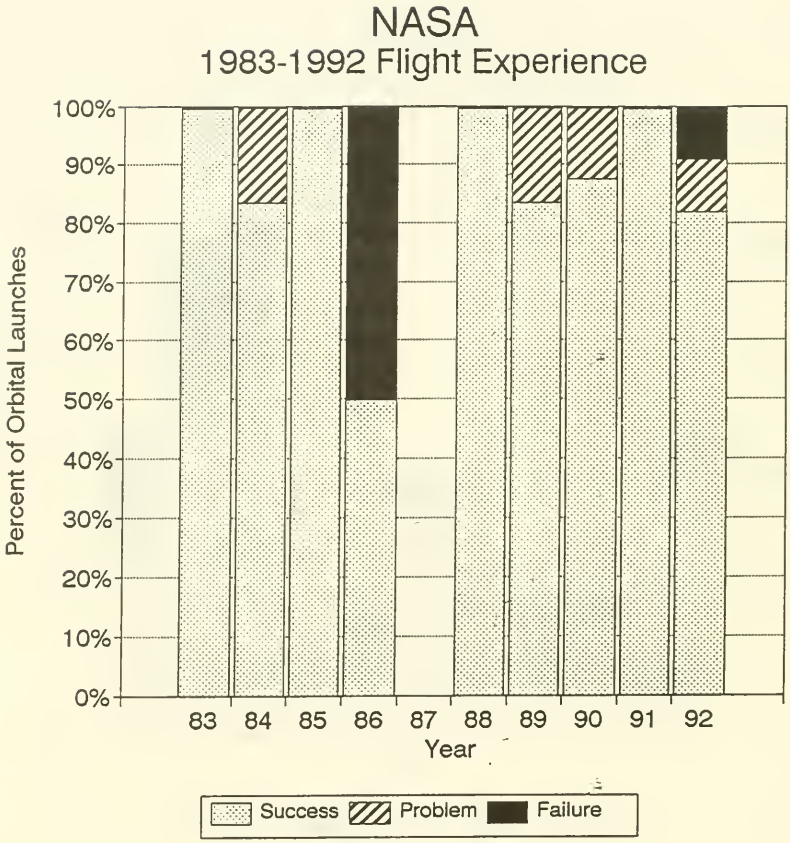
But when a NASA mission fails, much greater investments of time and money are at stake, and the public takes considerable notice. This lesson was imprinted on NASA from the first failures of Vanguard, and reinforced by Apollo 204, Challenger, and Hubble. Given both the material and political stakes, NASA cannot afford the tolerance for risk that is normal for experimental military programs.

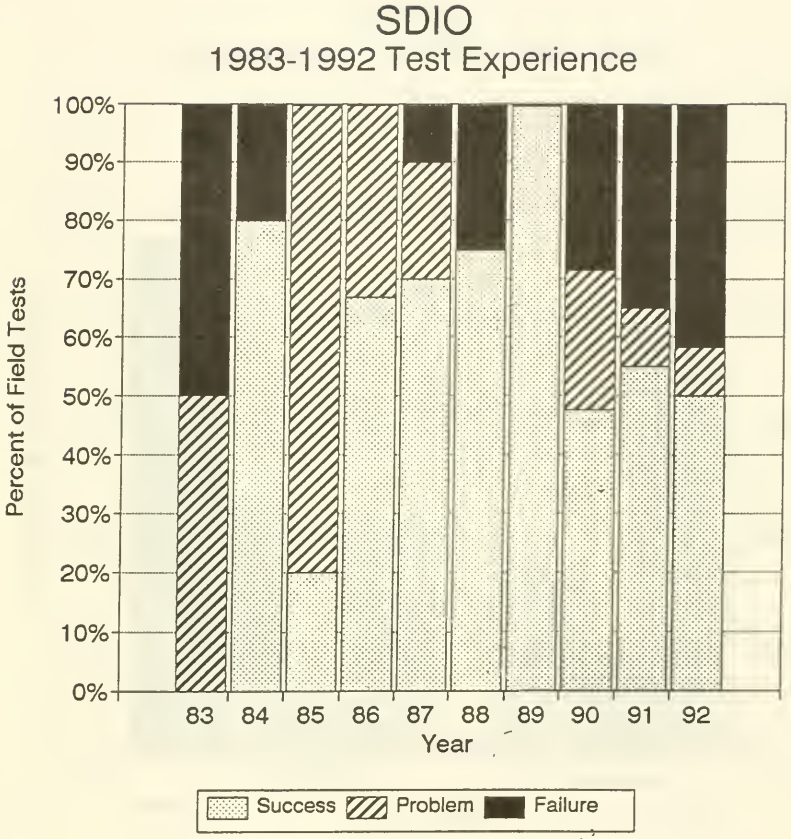
From 1983 through 1992, NASA has successfully completed 47 space flights, while experiencing significant problems on five missions (Hubble, Galileo, GOES-Next, Tethered Satellite System, and the PAM upper stage). Only two missions have failed completely (Challenger and Mars Observer), with nine additional projects being canceled prior to flight. Thus three-quarters of the projects NASA has initiated have resulted in successful flights. In contrast, over the same period, one out of five SDIO tests and projects were canceled prior to flight. Another fifth failed completely, and nearly as many experienced significant problems. Indeed, from 1990 through 1992, approximately half of SDIO's tests were complete or partial failures. There is little here for NASA to emulate.

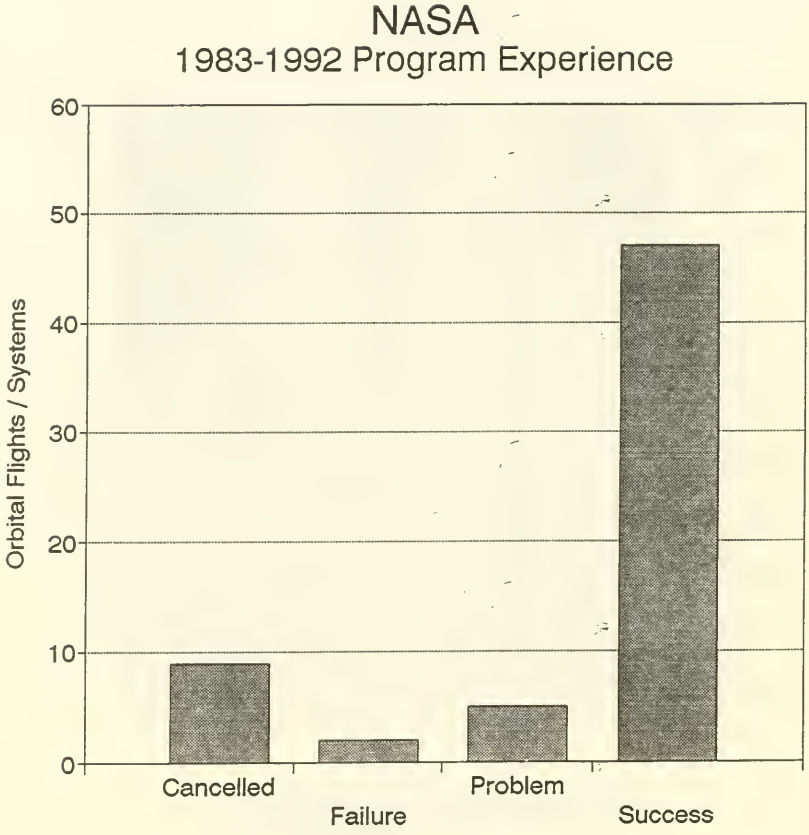
NASA must develop a new risk management strategy, now that many scientific payloads are to launched on expendable launch vehicles. When these payloads were intended for launch on the Shuttle, it could be assumed that the launch vehicle was reliable. Under this assumption, building a single, one-of-a-king payload such as Hubble or Compton made sense. But expendable launch vehicles must be assumed to be unreliable (90% to 98% reliability). With this assumption, an appropriate risk management philosophy would consist of larger numbers of smaller payloads, to reduce the impact of inevitable launch failures. But there are limits to the applicability of this approach to automated payloads, and it is inapplicable to piloted missions.

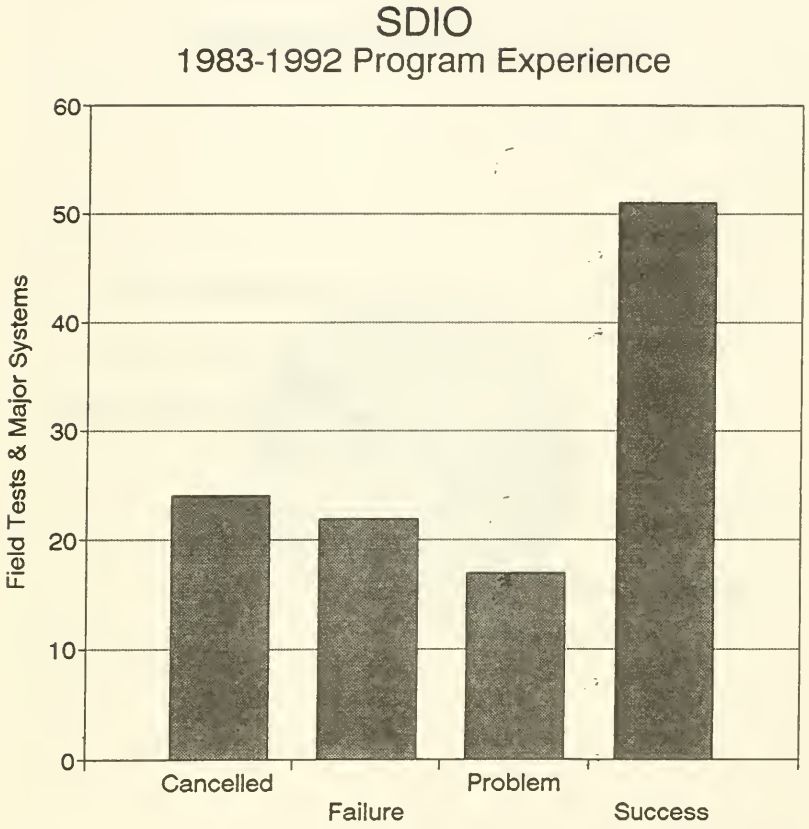

NASA
1983-1992 Flight Experience
Orbital Launches
25
20
15
10
5
0
83
84
85
86
87
88
89
90
91
92
Year
Success
Problem
Failure


SDIO
1983-1992 Test Experience
Field Tests
25
20
15
10
5
0
83
84
85
86
87
88
89
90
91
92
Year
Success
Problem
Failure

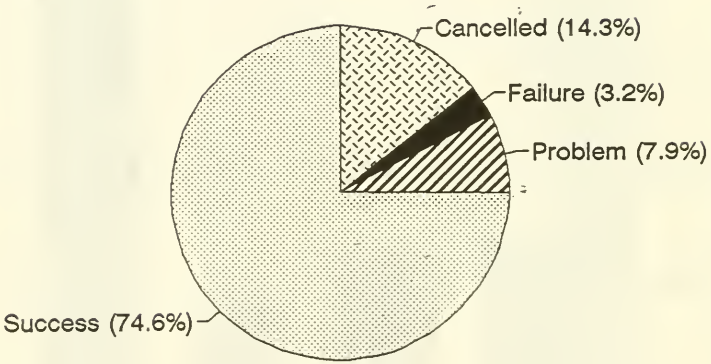

NASA
1983-1992 Flight Experience
Percent of Orbital Launches
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
83
84
85
86
87
88
89
90
91
92
Year
Success
Problem
Failure


SDIO
1983-1992 Test Experience
Percent of Field Tests
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
83
84
85
86
87
88
89
90
91
92
Year
Success
Problem
Failure

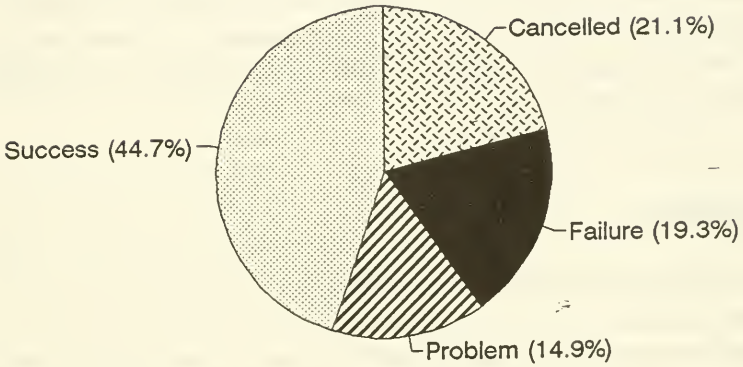

NASA
1983-1992 Program Experience
Orbital Flights / Systems
60
50
40
30
20
10
0
Cancelled
Failure
Problem
Success


SDIO
1983-1992 Program Experience
Field Tests & Major Systems
60
50
40
30
20
10
0
Cancelled
Failure
Problem
Success

NASA
1983-1992 Project Experience



SDIO
1983-1992 Project Experience



3 - NASA Management Structure

The NASA of today is largely a product of the Apollo era, in which the goal of the agency was quite clear. Since that time, NASA has sought to respond to a more diffuse set of political requirements. And with the end of the Cold War, NASA faces a more complex political environment than ever. But its Apollo-era structure is poorly suited to enable NASA to respond to these new political requirements.

NASA probably has something to learn from the Defense Department, but it probably does not consist of emulating the SDIO philosophy. Rather, it consists of emulating the Defense Department model of centralized and systematic policy formulation, and budget and program management. At present NASA is simply not organized to consistently formulate and advocate coherent and compelling rationales for its activities, or to successfully supervise program implementation.

A - Field Centers

NASA's fundamental institutional weakness derives from its origin, in which a variety of disparate institutions, many with proud histories and distinct institutional cultures, were aggregated under the common rubric of NASA Field Centers. In reality, there is no NASA space program – each Field Center has its own space program, which NASA headquarters attempts, with limited success, to unite into some common effort. NASA is not a single spaceship, it is rather a collection of spare parts flying in more or less close formation. The current pattern of a weak Headquarters attempting with limited success to impose coherence on highly autonomous Field Centers remains a recipe for failure.

The pernicious effects of excessive Field Center autonomy were recognized in the wake

of the Challenger accident. As a result of the Rogers Commission investigation, safety and quality assurance functions, which had formerly been the responsibility of each Field Center, were placed under the central control of Headquarters.

But similar weaknesses in other areas persist. Each Field Center utilizes distinct and incompatible accounting procedures and systems, frustrating efforts to comprehensively manage NASA's budget. Even the public affairs offices of each Field Center use incompatible audio-visual systems, compromising NASA's ability to fulfill its responsibility under the 1958 Space Act to inform the public of its activities and findings. No doubt a systematic evaluation of NASA would disclose other areas in which current practices undermine the coherence and effectiveness of our civil space effort.

One important lesson of the Apollo era was the recognition that the jealousy and autonomy of the Field Centers precluded management of one Center by another. Thus to coordinate the efforts of various Centers on the Lunar landing effort, an Apollo Program Office was created at Headquarters, to give central direction to the program. This important lesson was the genesis of the Space Station Program Office at Reston, VA. Regrettably, the Johnson Space Center was never reconciled to the existence of this Office, and its continual efforts to recapture control of the Space Station effort were recently rewarded with success.

The potentially negative consequences of this move may be offset by plans to remove the Johnson Space Center Director from the management of the Space Station program. If this precedent is applied more widely, it could mark the beginning of an important and beneficial evolution in NASA management.

At present, each Center director is the central point of contact and responsibility between program offices at NASA Headquarters and the project office at the Center. This reinforces the autonomy of the Centers as well as the weakness of Headquarters. It would be far

preferable to remove the Center directors from the management chain. They should instead be responsible for providing support services to projects which would report directly to Headquarters.

B - Political Appointments

A related source of NASA's institutional weakness derives from its status as a "non-political" Administration. We do not have a Department of Space, and as a result there are an unusually small number of presidential appointments that can be made at NASA. There are only three PAS (Presidential appointee with Senate confirmation) positions at NASA:

Administrator
Deputy Administrator
Inspector General

There are also a handful of lower-level Schedule C and Non-career SES appointments, but all major policy positions (Associate and Assistant Administrators) are career SES. The total number of political appointees at NASA is fewer than a dozen. This is very sharp contrast to the situation at other agencies that have similar technical missions.

	NASA	DOE	EPA
Budget $B	14	16	6
Appointees	10	100	44
$B/Appointee	1.4	0.16	0.14

The Energy Department, which has about the same budget as NASA, and has a similar structure (with a number of field centers which are the primary focus of its work), has ten times as many political appointees as has NASA. And the Environmental Protection Agency, with a much smaller budget, has four times as many political appointees as does NASA. To put this in perspective, both DOE and EPA have one political appointee for approximately $150 million in budget authority, while NASA has on political appointee for roughly each $1.5 billion in budget authority.

At these other agencies, Assistant Secretaries and other senior officials are charged with formulating and implementing the President's policies and programs. Their authority over agency operations derives from their status as the proximate representatives of the President's electoral mandate, conjoined with the advice and consent of the Congress, through the confirmation process.

In contrast, at NASA, Associate Administrators and Headquarters generally are largely bereft of such explicit connection with the centers and sources of political power. Headquarters is thus little more than the one Field Center that lacks a supportive Congressional delegation. This asymmetry in political clout further undermines the possibilities of effective central control of the civil space effort.

B - Policy Planning

One of the distinguishing characteristics of NASA in recent years has been its difficulty in articulating coherent and compelling rationales for its programs. Some may contend that this difficulty results from the intrinsic absence of coherent and compelling rationales for some of the projects upon which NASA has embarked. But NASA's present institutional incapacities preclude resolving this issue.

NASA was founded in 1958, a product of the bomber gap, the missile gap, and the space race. NASA was forged in the white heat of Soviet-American competition, tempered by the successful landing of Americans on the Moon in 1969, and for the two decades thereafter was sustained by the lingering rivalry with the Soviet Union. But today the Soviet Union is no more. We have at last emerged from that long twilight struggle that defined the second half of the twentieth century. All of our institutions are now seeking to define their place in this new world, some with greater success than others.

Unfortunately, NASA as an institution is distinguished by the singular absence of an organizational focus for developing and articulating program rationale and policy. This defect is a self-inflicted wound. In 1962, NASA Administrator James Webb discontinued the ongoing NASA Long Range Planning activity, concerned that such efforts would distract attention and political support from the goal of winning the race to the Moon.

Since then, NASA has resorted to a variety of ad-hoc planning devices. Each Code at Headquarters supports its own long-range planning activity, though with little effective coordination. In recent years, Agency-wide policy planning and rationale development activities have been scattered among a variety of offices, including the Associate Deputy Administrator, the NASA Advisory Council, Associate Administrator for External Relations, the Associate Administrator for Legislative Affairs, the Associate Administrator for Public Affairs, and the Associate Administrator for Policy and International Relations. These offices, and their responsibilities, have frequently changed, more as a result of the personalities involved than as a result of some larger plan. In each of these offices, only a handful of individuals are charged with policy development.

This is in sharp contrast to the State Department, with its Policy Planning Staff. It is also in sharp contrast to the Defense Department, where the immediate subordinates of the Secretary are Under Secretaries for Acquisition and for Policy. That the Defense

Department has had much less difficulty than has NASA in articulating and advancing post-Cold War rationales for its programs is at least in part due to the existence of a well established organization for development and articulation of policy.

Over the past four years the Space Council, and the various Commissions and Panels it appointed, have attempted to perform this function, these entities simply lack the institutional resources to provide the needed guidance. The Scowcroft and Packard Commissions performed useful services for the Defense Department, but the implementation of their recommendations rested on the institutional capacities of the Department. Such institutional capacities are not in evidence at NASA.

Cooperation with Russia in the space station program will impose even greater institutional burdens on NASA. The Defense Department is often accused of trying to set up a "Little State Department" in the Office of the Under-Secretary of Defense for Policy. The wide-ranging national security responsibilities of the Department certainly provide incentives for such efforts. With its new-found centrality to American relations with Russia, NASA would be well advised to follow this precedent. But NASA's foreign policy shop has hitherto faced only the rather routine and modest challenges of treating with Europe, Japan and Canada. NASA clearly lacks either the number or type of personnel that will be required to manage the far more demanding relationship with Russia. Absent immediate augmentation, this is clearly a formula for future grief.

C - Program Analysis and Evaluation

Seemingly pessimistic assessments about the inevitability of NASA's recent problems proceed from two assumptions: that there is no discernable trend in NASA's performance over the decades: and that the trend toward ever larger spacecraft is driven by the logic

of scientific discovery. These are both debatable propositions, and modesty dictates that they be treated as less than self evident. But equal agnosticism is also required for the contrary propositions which are presently in vogue.

The sad reality is that little more than anecdotal evidence exists to support any conclusions, in either direction. Billions of taxpayer's dollars continue to be spent based on little more than hear-say beliefs concerning engineering and management practices and alternatives.

Despite NASA's expenditure of roughly half a trillion dollars since the dawn of the space age, there has been only a fragmentary effort to capture the lessons learned from the agency's successes and failures. Although some NASA programs have been the subject of official histories, this remains the exception rather than the rule. And there has been no attempt to systematically analyze project histories to understand what went right and what went wrong. Thus there is today no accepted definition of what constitutes "best practice" that could be used by decision-makers to evaluate current program plans.

Unfortunately, this is no accident, as there is no institutional entity within NASA charged with this vital function. While the NASA History Office continues its exemplary efforts, the synthetic analysis of lessons learned is largely is beyond its purview, and it certainly lacks the mandate to apply such lessons to ongoing programs.

Again, this is in stark contrast to the situation at the Defense Department, where the staff of Office of Program Analysis and Evaluation is dedicated to addressing precisely such questions. The elaborate procedures of the Defense Acquisition Board, replete with independent reviews and formal criteria for proceeding to subsequent phases of development, have no apparent equivalents at NASA. That Defense budgets and acquisition programs nonetheless go awry, despite these institutional safeguards, suggests the potential for troubled programs that would exist in their complete absence, as appears to be the case

at NASA.

Thus we are presented with the sad spectacle of the NASA Administrator publicly disavowing program cost estimates offered by senior Space Station officials. But how could it be otherwise, when the Administrator lacks the institutional capability for producing independent cost estimates?

While everyone is entitled to their own opinion, no one is entitled to their own facts. Unfortunately at NASA, facts are in ostentatiously short supply, and as a result, opinions are too often substituted for substantive analysis.

4 - Post-Cold War Challenges

Our recent setbacks offers lessons for the future direction of America's space effort. These lessons are united by the common theme that the end of the Cold War provides both new imperatives and new opportunities for space exploration and development.

Space Station Freedom was conceived in the depths of the Cold War, as a response to the Soviet Space Station – Mir – and a demonstration of Western unity against the "Evil Empire." But the end of the Cold War, and thus of the Space Race, has deprived Freedom of its ultimate rationale. And there is no reason to believe that the scientific of commercial benefits of this project would repay even a fraction of the $10-15 billion that will be required for the Station over the next five years.

Hence, in June, the House of Representatives approved the Space Station's budget by a one vote margin, and a similarly close vote is expected later this year in the Senate.

The potential consequences of the Space Station's cancellation were previewed in the aborted launch of the Shuttle Discovery in August, following an earlier aborted launch in March. Fortunately, in these cases, problems were detected before liftoff. But according to NASA's own estimates, the odds of another Challenger accident are no better than 1 in 78 each time the Shuttle flies. With eight flights scheduled each year, there is a great likelihood that we will be confronted with another Challenger accident before the end of this decade. In the absence of a permanently occupied space station, this could spell the end of the American piloted space effort.

Responding to these challenges, President Clinton and NASA Administrator Dan Goldin have opened negotiations with Russia to attempt to combine Freedom with Mir. If successful, these negotiations will result in a truly international space station that will be

a highly visible exemplar of the end of the Cold War. More practically, such collaboration will provide Russian aerospace workers with hope for the future, thereby furthering the reform process in Russia and reducing the threat of these trained people going to work on North Korean or Libyan missile projects. American aerospace workers will also benefit, as the Space Station program will now be on firmer political ground, reducing the risk of cutback or cancellation.

The lesson here is that space is vast, and its exploration exceeds the means of any one country. This confrontation with the vastness of space reduces the dangers of confrontations on Earth, as it reinforces our sense of common humanity. Just as competition in space was a defining element of the Cold War, cooperation in space will help us define a less-threatening post-Cold War world.

The management challenges of cooperating with Russia will dwarf those of competing with the Soviet Union. Although we are only just now beginning to contemplate these challenges, it is already clear that NASA's present institutional arrangements will quickly prove inadequate to the tasks ahead.

The coherence of the American civil space program has been increasingly blighted by the conflicting institutional cultures at the NASA Field Centers, with each convinced that it alone best understands how to run a space program. But such cultural conflicts will be dwarfed by those we will encounter between the Russian and American space communities. Though America won the race to the Moon, the Russians look with pride to Sputnik and Gagarin, and two decades of experience operating space stations in orbit. International cooperation in Space Station Freedom, in which NASA was the preeminent partner, was a difficult process.

Cooperation with a truly equal Russian partner will require a revolution in NASA's

collective institutional culture. Such a revolution will be absolutely essential to the success of this new venture. In the past, NASA was the exemplar of American technological superiority. Today, the challenges of the space frontier have made this perhaps too heavy a burden for NASA. In the future, NASA will be the exemplar of the new partnership between America and Russia. Cooperation in space will be widely perceived, both in America and Russia, as a barometer of the progress of this partnership. NASA as presently constituted is poorly prepared to play this important role.

There are also more immediate challenges. While our understanding of the structure and function of the Russian space community is infinitely greater than it was a few years ago, we remain disturbingly ignorant of this vastly complex entity.

Some things are clear. The reports of the death of the Baikonur Cosmodrome, which will play a central role in the new joint space station, have been greatly exaggerated. While its precise status will remain a source of discussion between Russia and Kazakhstan, there is no prospect of the sudden collapse of launch capabilities.

It is also clear that the various Russian design bureaus and production associations have a long history of intense conflict with each other that make the institutional conflicts at NASA appear as a model of sweetness and light. It is increasingly clear that the Ministry of General Machine Building, which formerly supervised these entities, would have envied even the light hand of control exercised by NASA Headquarters over NASA Field Centers. The general secretiveness of the Soviet era was reinforced by the secretiveness of the design bureaus with respect to their nominal political masters. Knowledge is power, and the Chief Designer's power derived from a monopoly on the knowledge of their institution's capabilities and weaknesses. The difficulties that NASA officials have experienced this year in extracting cost and performance data from their Russian interlocutors in the space station negotiations would surely be painfully familiar to the former ministers of General

Machine Building.

Past NASA problems, such as the inadequate testing of the Hubble Space Telescope mirror, derived in part from a failure to adequately "penetrate the contractor," in NASA parlance. Achieving adequate contractor penetration will be an enduring challenge of cooperation with our Russian partners. Success in this effort will largely depend on engaging the talents of Russian institutions, like the Central Institute of Machine Building, which have long practice in such efforts. However, these entities remain largely opaque to NASA at present. And NASA largely lacks the institutional capabilities for these tasks.

It must also be recognized that at present, our entire civil and commercial space policy with respect to Russia is predicated on the extraordinary disparity between the value of the ruble and the dollar, currently about 1000 to 1. At current exchange rates, the annual wage of a Russian aerospace worker is about $1,000, a few percent of that of American workers. Consequently, substantial Russian technical capabilities can be obtained at modest cost to American taxpayers. However, this grotesque disparity will not persist indefinitely. At some point, hopefully before the end of this decade, the Russian economy will return to some semblance of normalcy, and with it the ruble exchange rate. While Russian wages will remain below those of the West, significant increases in the cost of Russian labor are certain, and the experience of economic stabilization in countries such as Poland suggest that these increases may occur with unexpected suddenness, on a time scale of many months, rather than several years. American decision-makers must be prepared for dramatic, perhaps a factor of five or ten, increases in the costs of Russian space contract activity.

We would be well advised to recall the counsel of Winston Churchill, who as planning for the Normandy invasion commenced, cautioned his generals that 'the difficulties will suggest themselves.'

We should take this moment of national reflection on our future in space to refocus our space program toward the new opportunities offered by the end of the Cold War. Failure is the price of success, and no worthy endeavor is without cost. But we will be prepared to continue despite setback only if we know the ultimate purpose of our efforts. Using space to build a peaceful world order is such a worthy purpose.

Mr. CONYERS. Dr. McCurdy, what can you add to help us not only understand the problem but do something about it? You know, this is not an academic exercise. We are trying to make ourselves a better government, and you can't do that with the kind of debt we are amassing, and we can't stop amassing debt with the kind of practices that we are examining here today.

STATEMENT OF HOWARD E. McCURDY, PROFESSOR OF PUBLIC AFFAIRS, AMERICAN UNIVERSITY

Dr. MCCURDY. Let me try and give you some historical perspective on that. There has been a lot of discussion today about the need for centralized program management within NASA, and certainly that has been recommended by a number of groups, most recently by the Vest Committee, looking at the space station program.

There has also been some discussion about NASA's culture being highly decentralized and resisting this kind of central program management, but I would like to tell you based on the study I did of NASA's overall organizational culture that it wasn't always that way.

During the 1960's, when NASA had a very specific mandate, it develop centralized program management offices and techniques which served the agency exceptionally well for the Apollo era and for some of the other multicenter projects that NASA was engaged in at that time. What happened, as I have been told by agency employees, is that around 1970 when the agency went through its period of contraction, it abandoned a number of those centralized management procedures largely, I would say for many reasons, but largely I would say because the survival of its field centers was threatened and it wanted to strengthen its field centers.

Now we have 20 years of experience under that system. Administrator Goldin is attempting to institute centralized program management procedures, but NASA, as you are learning today, still has a long way to go. If you look back to the 1960's, there are a number of models that existed at that time that show how you can effectively organize multicenter programs using strong central management. The model for project Apollo at that time was the central Apollo program office here in Washington, DC under General Samuel Phillips.

I would also say that if you look at other high performance organizations that have worked exceptionally well, such as the Manhattan project during World War II or the national radar project, also during World War II, or the Tennessee Valley Authority when it worked so well during the 1930's, that all of those organizations had a history of some sort of strong central control from the very top of the organization to hold the organization in line.

Mr. CONYERS. But they were also under extraordinary pressures to produce.

Dr. MCCURDY. That is correct.

Mr. CONYERS. Doesn't that count for something?

Dr. MCCURDY. That is correct. You asked the question why are we where we are. Part of the reason is that NASA's environment has changed. It was created for a period of cold war competition that no longer exists.

Another reason why NASA has changed has nothing to do at all with NASA, it has to do with the Federal Government as a whole, and that is the excessive proliferation of administrative requirements on agencies which have been listed in detail in a number of reports, most recently by the Vice President's National Performance Review.

NASA faces administrative requirements that it did not face, that no agencies faced in the 1960's. So part of what you see happening in NASA is part of a general trend affecting all administrative agencies. If I could say one other thing, too, there has been a lot of discussion about centralized program management, but NASA worked as well as it did in the 1960's because there was another half to that formula, and the other half was that NASA had tremendous in-house technical capability which it had acquired through some 20 to 40 years of prior institution building in other agencies that existed long before NASA was created, such as the National Advisory Committee for Aeronautics. They had shop capability. They had engineering capability that was separate from the program management offices. When the program managers got in trouble, they could turn for technical advice to expert engineers like Max Faget who designed the Mercury spacecraft and ran the engineering directorate at the Johnson Space Center. That gave them the capability to effectively monitor contracts.

At the Marshall Space Flight Center, Wernher von Braun and the people who worked for him would take rockets and rocket equipment that came from the contractors and disassemble it either at the Marshall Center or at the Kennedy Space Center to make sure that the contractors built it the way that NASA had designed it. The reason they could do that is first because in many cases they had built that equipment themselves on the grounds of the Marshall Center using their own shops, so they knew how the equipment was supposed to be put together, they understood what it should cost, and they had the capability to penetrate contractors to make sure that the goods were delivered as promised. So those two things are very important in any NASA program, centralized program management, but at the same time the technical capability in the labs and shops and engineering directorates that gives NASA the know-how it needs to monitor contracts.

Mr. CONYERS. Thank you for your comments.

[The prepared statement of Dr. McCurdy follows:]

Testimony before the

Legislation and National Security Subcommittee
Committee on Government Operations

Howard E. McCurdy
Professor of Public Affairs
The American University

October 6, 1993

As a professor who writes about the history and management of the U.S. space program, I was asked shortly after the Challenger accident to prepare a book on NASA's organizational culture. Specifically, I was asked by a number of people within NASA to identify the cultural norms that helped the initial space program to work so well and determine the degree to which those factors had changed. I interviewed many of the people who managed the NASA space program during the 1960s as well as a counterpart group from the 1980s. Additionally, I surveyed NASA employees (in 1988) and searched through agency archives. Last winter I published a book based on the study, findings from which are summarized in this statement and a chapter attached to it. The book relates the beliefs of the people who have managed the U.S. civilian space program since its inception in 1958. It is essentially their story.

Organizations, like societies as a whole, develop distinct cultures. These cultures consist of the beliefs, values, assumptions, and norms of behavior that members of the organization carry with them as they go about their work. In general, the culture defines "the way that we do things here." An understanding of NASA's organizational culture helps to explain what has worked well in the past and what sort of management reforms are likely to work well (or be resisted) in the future.

The organizational culture that supported NASA during the 1960s was quite unique. The Apollo mission, NASA's most ambitious undertaking, brought together three well established cultures whose roots considerably preceded President Kennedy's 1961 decision to go to the Moon. Project Apollo combined the flight test culture from the 40-year old National Advisory Committee for Aeronautics (NACA) with the 23-year old German rocket culture under Wernher von Braun and the cultural practices from the U.S. Air Force used during the 1950s for the crash program to develop the ICBM. The success of Project Apollo drew upon cultural habits in which the government had invested heavily prior to their employment for the lunar expeditions. Effective cultures take many years to develop, and may be employed in ways not anticipated by their framers.

NASA's original culture placed a great deal of emphasis upon the value of testing and research, of risk-taking, of hands-on activity, and of maintaining NASA's in-house technical capability. The people who ran NASA believed that they had the capability to recruit exceptional people to work on the civilian space program. They developed elaborate management systems, often highly centralized, to coordinate large projects and guard against failure.

As the space program matured, NASA officials found it harder to practice these cultural beliefs. Among the NASA officials that I interviewed, there was widespread agreement that NASA began to change around 1970. In general, they said that the agency became more bureaucratic, more conservative, and more preoccupied with its own survival. They believed that NASA managers were less inclined to take risks and that NASA employees were more likely to find themselves performing administrative duties rather than engaging in basic science or engineering.

Two factors motivated this cultural change. First, during the 1970s and 1980s the administrative burden placed on all federal agencies grew. This occurred in large part because of the proliferation of federal administrative requirements and the growth of external oversight. Increased congressional oversight of administrative agencies contributed to this trend. In this regard, NASA's evolution toward more administration and bureaucracy was part of a broader movement underway throughout the federal government.

Second, NASA's culture changed in response to forces peculiar to the U.S. space program. The contraction of U.S. space activities following the Apollo build-up set in motion a series of events that altered the overall program. Employment and promotion opportunities declined, which caused the work force to grow older and restricted the flow of "new blood" into the agency. Pressures to maintain the field centers encouraged NASA officials to abandon administrative practices developed during the Apollo era, such as the centralized program management concept. "Life cycle" changes such as these are typical among government agencies moving through periods of expansion and contraction.

This was a very difficult period for NASA. Unlike other crash programs such as the Manhattan Project or the radar development project during World War II, the space program did not disappear once the initial race was won. NASA officials had to take the high performance culture developed for their early endeavors and make it a permanent fixture. This proved very difficult to do.

NASA employees still believe deeply in the efficacy of the original culture. Since 1970, however, they have found it increasingly hard to practice the tenets of that culture. High performance cultures of the sort that NASA developed during the Apollo era are very difficult to maintain.

Take for example the issue of contracting out. The Advisory Committee on the Future of the U.S. Space Program (chaired by Norman Augustine) recently recommended that NASA adopt the Department of Defense system for supervising aerospace contractors. The Department of Defense uses fewer government employees and relies more on contractors for managing the development of its space systems than NASA does.

This approach is totally contrary to the original NASA culture. NASA has a strong tradition of in-house technical capability and contractor penetration. NASA employees believe that the opportunity for hands-on experience attracts exceptional employees and keeps them smart. As Wernher von Braun told the House Science and Astronautics Committee in 1964, "a good engineer sets stale very fast if he doesn't keep his hands dirty." External pressures, however, in particular the development of a robust aerospace industry, have persistently pushed NASA away from its traditional mode.

A second example concerns NASA's ability to attract exceptional employees. The original NASA culture was based on the assumption that the agency could mobilize the best available people to tackle the technical challenges of space flight. This produced a work ethic not unlike that developed by the United States during World War II, when the nation mobilized large numbers of civilians to participate for relatively short periods of time in the overall war effort. In order to expedite the mobilization of talent for the space program, Congress excepted more than 700 NASA positions from civil service pay regulations during its formative years. Freedom from civil service regulations gave NASA considerable flexibility in drawing talent from industry and universities.

A government agency that cannot rotate people in and out eventually turns into a career bureaucracy. Within NASA, this development has been furthered by conflict of interest laws and civil service regulations that restrict mobility. Space agency officials do not like this development, but they have felt relatively powerless to prevent it.

A third example concerns the attitudes of NASA employees toward risk and failure. NASA's original employees took risks and expected to fail. NASA dispatched six Ranger probes to the Moon before the first one worked in 1964. In 1966, nearly one-fifth of the missions and payloads arriving in space failed in some fashion. NASA officials rated the Saturn V rocket test immediately preceding the first 1968 flight around the Moon as unsuccessful, but they went ahead with the lunar flight anyway.

NASA managers anticipated failure. As a consequence of knowing that they were going to fail, NASA managers developed elaborate safeguards that elevated the overall performance of the space program. Beginning with the 1967 fire on Launch Complex 34 that took three astronauts' lives, that perspective changed. Public and congressional tolerance for failure narrowed.

NASA employees believe that their top managers as a result grew cautious and inclined to avoid risks. While this caused NASA's success rates to climb, it also altered the underlying culture. Many officials said that they felt constrained from an open discussion of risks because of the damage it could do to the success of the program.

The legacy of NASA's original culture still exists within the agency, in spite of the difficulties of practicing it. NASA managers understand the need for cultural renewal, as the statements of top officals reveal. In contemplating future management reforms, it would be wise to consider whether such changes strengthen the underlying culture or create something new. The successful culture of the 1960s took many years to develop. Any new culture, or a revitalization of the old, will also require patience and long-term investment.

Howard E. McCurdy

Inside NASA

High Technology and Organizational Change in the U.S. Space Program

The Johns Hopkins University Press
Baltimore and London
1993

Conclusion: Governmental Performance and Cultural Instability

We choose to go to the moon in this decade and to do the other things not because they are easy, but because they are hard.—John F. Kennedy, 1962

Congress created the National Aeronautics and Space Administration in 1958 for "the preservation of the role of the United States as a leader in aeronautical and space science and technology."[1] In 1961 President John F. Kennedy gave NASA the long-range goal "before this decade is out, of landing a man on the moon and returning him safely to earth."[2] Borrowing extensively from the agencies that came together to form NASA, agency employees fashioned a strong organizational culture. That culture supported exceptionally high levels of performance for tasks very difficult to perform.

The culture was not long-lived. Even before Project Apollo drew to a close, the culture began a process of transformation. Practices that had exemplified the early culture gave way to different organizational norms. Some of the original beliefs changed. NASA took on the characteristics of a more conventional government bureaucracy.

What was it that made the original culture work so well? Why did that culture change? The NASA experience suggests that high-performance cultures of the sort initially developed within the civilian space program are inherently unstable. Forces that affect the government as a whole undermine them. This chapter describes the similarities between NASA's original norms and the cultures found in other high-performance organizations, and suggests why these cultures invariably wither when tried in modern government.

NASA's Original Culture

The people who created NASA assembled a confederation of cultures, a combination of traditions from existing government agencies each with its own philosophy of doing things. NASA's early cultural norms emerged from common traditions and clashing beliefs, shaped by the requirements necessary to get the space program under way. Interviews with people who worked for NASA during these years, supported by survey data and material from NASA archives, systematically reveal those norms.

From the beginning, officials representing the organizations that came together to form NASA advocated research, testing, and verification as the primary methodology for determining what worked and what did not. Agency employees wanted to test their hardware exhaustively, even the products that came ready-made from contractors. They accepted testing and verification, especially flight tests, as the primary means for determining truth.

In order to carry out their work, officials from the predecessor agencies firmly believed that NASA had to maintain its own in-house technical capability. Shops and laboratories on the grounds of the field centers where NASA employees worked physically supported that capability. In-house capability provided a training ground for space age managers by requiring engineers and scientists to take responsibility for entire projects. It provided NASA employees with the know-how needed to effectively monitor the work of contractors.

NASA employees wanted America's civilian space agency to be a hands-on organization. From their government laboratories to Mission Control, NASA employees wanted to work with the machinery, do space science themselves, and closely supervise the work of contractors when contractors became involved. Hands-on work kept NASA employees technically sharp, and it helped agency executives attract exceptional people to the civil service work force.

The assumption that NASA attracted exceptional people was a key element in the agency's culture. Since they believed that they had recruited exceptional people, agency leaders felt justified in adopting procedures that exceptional people could carry out. The expectation of hard work and the agency's much-touted attention to detail drew on the assumption that NASA had recruited people who would behave in exceptional ways. So did the expectation that NASA employees possessed the know-how to tell contractors exactly what the agency wanted done.

The original technical culture contained strong nor about risk and failure. As members of a research and exploration agency, NASA employees viewed risk and failure as an inevitable part of their business. They expected their people to take risks and they tolerated mistakes, although not the same mistake twice. They viewed failure as the normal way by which engineers learned to improve the rockets and spacecraft that they flew.[3] NASA employees expected trouble to occur. Because they anticipated trouble, they felt better prepared to avoid it. They developed techniques for lowering the likelihood of failure, including communication networks, redundancy engineering, and extensive testing.

The people who staffed the new space agency shared a frontier mentality. They did not want to become just another government operation performing the same tasks year after year. They wanted to design and test and build and move on to new challenges. They became advocates for new initiatives. They developed new technologies where necessary but relied upon proven technologies where possible.

The creation of this technical culture during NASA's early years received support from the values that the first generation of NASA employees and scientists brought to the infant space program. Raised during the Great Depression and the Second World War, this generation of employees accepted the middle-class values of honesty and hard work as natural parts of life. As first-generation entrants to a professional corps, they pursued technical solutions to space flight problems not only because they were trained to do so, but because engineering and science had provided their means for climbing the social and economic ladder.

Together, these elements created a culture in which NASA civil servants felt empowered to exercise a high degree of discretion and technical judgment in carrying out their work. Such characteristics are typical of high-performance organizations. In her study of high-performing firms in the private sector, Rosabeth Moss Kanter suggests that "integrative" companies develop a greater capacity for innovation than firms that adopt more traditional or "segmentalist" norms. Integrative firms rely on a decentralized matrix structure rather than a centralized hierarchy. Information flow is open and horizontal in integrative firms. Their organizational culture is clear and tends to favor individual initiative and risk taking.[4]

In their study of public agencies that perform operational tasks at high levels of reliability, Todd LaPorte and other members of the High Reliability Organization Project also emphasize the importance of local

respon. .ty. LaPorte and Paula Consolini describe how strict military authority on a navy aircraft carrier gives way to local discretion as jet traffic increases or weather deteriorates: "Collegial authority (and decision) patterns overlay bureaucratic ones as the tempo of operations increases. Formal rank and status declines as a reason for obedience. Hierarchical rank defers to the technical expertise often held by those of lower formal rank."[5]

Workers in high-reliability organizations restructure themselves into new formations as the tempo of work picks up or unanticipated situations occur. According to LaPorte, the hierarchy that normally guides work when affairs are slow steps aside so as to allow employees on the action line to exercise more discretion. Agency chiefs insist upon frequent communications in order to anticipate and correct errors. While NASA managers face different challenges than those confronting aircraft carrier captains at sea, both rely upon cultures that stress open communications, technical judgment of people in the field, and—most important—an overlay of strong control.

Observers should not be misled into thinking that the early NASA culture emphasized only technical discretion. To complete complicated programs like Project Apollo, NASA executives installed tight management systems. They imported rigorous management practices from the Air Force Ballistic Missile Program. George Low, manager of the Apollo spacecraft and later Deputy Administrator of NASA, explained the importance of the latter. "We established design standards which all of our systems had to meet and developed rigid procedures to assure that they were met," Low said. "We placed all changes under the most rigid of controls. Emphasis was on formality and discipline at every step along the way. Manufacturing and assembly were also carried out to exacting standards. . . . We specified how to solder, how to crimp wires, and controlled the process of plumbing. Every part of the system was known, its manufacture specified, and the people who performed intricate functions were specially tested and certified. . . . Formality, discipline and rigor were the key words in the test program. Test specifications were prescribed in advance, test results were audited and certified, all anomalies were reported, and all failures had to be understood and corrective action taken."[6]

Throughout the first decade, in large programs like Apollo, organizational pressures of program management and underlying norms of technical discretion coexisted. The different requirements of each produced a state of tension. The tension manifested itself in controversies over the proper role of contractors, testing philosophy, and the degree

to which officials at the NASA field centers would have to bend to a central office. Frequent conflict and a norm of wide-open communications accompanied this tension, allowing employees to sort out their differences and reach decisions. The tension between organizational pressures and technical requirements motivated NASA's early culture. It is characteristic of other high-performance organizations as well.

To energize the Manhattan Project that created the atom bomb, the U.S. government combined powerful forces of organization with a strong technical culture. Scientists under J. Robert Oppenheimer provided the technical base. Organizational pressures were created by the U.S. Army under the project commander, Brigadier General Leslie R. Groves.[7] High-reliability organizations combine tight management systems with local responsibility. The official hierarchy in such organizations can be quite strict. Leaders stress the importance of preprogrammed decisions, inculcating standard operating procedures into the work of operators through rigorous training. The tension that results is similar to the "loose-tight" properties observed by Peters and Waterman in their study of highly successful business firms.[8] It is also analogous to the properties found in "dialectical" organizations developed to deliver social services to low-income families.[9]

Organizational Culture and Change

The balance between strong technical discretion and tight management control did not last long in NASA. The second generation of NASA engineers and scientists did not receive the same latitude for technical discretion that the original members of the space agency were allowed. The second generation inherited an organization with much weaker central control and far more bureaucracy.

As NASA matured, it lost much of the administrative flexibility that characterized the early years. Bureaucratic procedures proliferated. Even as NASA employees held fast to their faith in the value of risk taking, they sensed their leadership becoming more cautious and less inclined to tolerate failure. Officials became more concerned with the survival of the organization. They adopted management schemes that sacrificed institutional flexibility in order to ensure institutional survival. The tight management practices imported from the U.S. Air Force disappeared. In their place, NASA executives adopted a weaker lead center system of decentralized responsibility. Overall, a subculture of institutionalized bureaucracy took hold.

As central controls grew weaker, so did the old technical culture

that once counterbalanced them. Increased pressures to contract out research and exploration activities diminished the tradition of doing sufficient work in-house. The desire to convert aspects of the exploration program such as the Space Transportation System into repetitively, predictable operations undercut the belief in extraterrestrial flight as inherently risky and bound to change. NASA officials did less flight testing and advanced the notion that computer analysis and ground testing provided an adequate substitute for the old norms. Professional employees watched the tolerance for risk and failure decrease at a time when their space vehicles and platforms grew more complex and prone to breakdowns. Even as they continued to believe in the exceptional quality of the NASA work force, they saw the distance between the average NASA employee and the business of space flight increase, diminishing the hands-on orientation that had been such an attractive feature of the original space program.

In the business world, organizational cultures do not easily change. Employees hold tight to the tenets of their cultures, resisting developments that would alter underlying norms. For many business executives, stable cultures create obstacles to needed change. Following the breakup of the Bell System, for example, managers at the American Telephone and Telegraph Company (AT&T) sought to change the underlying beliefs of employees so as to make the company more competitive. Among other goals, they sought to replace the employees' sense of technical superiority with a desire to compete openly in consumer markets. The employees responded by taking their beliefs underground, holding on to them in private and waiting for an opportunity to restore them to their rightful place.[10] In his discussion of cultural change, Edgar Schein notes the difficulty of changing fundamental assumptions and beliefs. As he observes, "Considerable change can take place in an organization's operations without the cultural paradigm's changing at all."[11]

NASA faced the opposite problem as it matured. Its high-performance culture underwent a process of transformation starting when the agency was barely ten years old. Organizational cultures consist—at a minimum—of practices, beliefs, and assumptions. Practices in NASA changed considerably. Beliefs changed some. Assumptions changed hardly at all. The overall culture changed in the sense that the remaining beliefs and assumptions lost their power to elicit appropriate practices. NASA professional employees, for example, held fast to their beliefs about risk and failure, but those beliefs no longer produced the desire to actually take risks and possibly fail. Results from the NASA

culture survey confirmed the extent to which the second generation of NASA employees continued to hold the same beliefs as the first. On seven key questions, NASA employees registered their agreement with traditional beliefs about testing, in-house technical capability, hands-on work, exceptional employees, risk and failure, and change (see the appendix: questions 2, 3, 5, 7, 8, 18, and 29). In every case save one, the beliefs of employees who joined NASA after 1969 did not diverge significantly from the beliefs of employees who joined in 1969 and earlier. Only in their desire for hands-on work did the newer generation slip away to any significant degree from the beliefs of the first generation.

The original generation of NASA employees passed on to the second generation many beliefs from the original era. NASA recruited people into the agency who—for whatever reason—continued to profess the original tenets. They found themselves incapable, however, of translating those basic beliefs into the full-blown culture of the first generation.

If the original culture was so successful, and its beliefs so pervasively held, then why did it change? Three factors contributed to the breakup of NASA's original culture. The environment supporting the early space program changed. The government as a whole grew more bureaucratic. And NASA aged. These developments created a basic instability between the assumptions and beliefs of NASA's early culture and the practices needed to support them. People in NASA had little control over these developments. The inevitable transformation of NASA shows how difficult the maintenance of a government culture supporting high-performance standards can be.

Cultural Environment

Invariably, the political environment that gives rise to a new agency creates favorable conditions for its development. Political environments, however, are quite volatile. Favorable conditions quickly disappear. It is very difficult to reproduce favorable environments once a government agency matures.

NASA appeared on the government scene at a time of extreme cold war tension during which the Soviet Union seriously challenged America's sense of technological superiority. If the Soviet Union could beat the United States in a space race, could it not also pull ahead in the quest for military superiority? NASA became a principal mechanism for affirming the supremacy of American technological know-how and

its spirit can-do. The space race during its infancy had an emotional value that went far beyond the scientific or technological value of the missions themselves.

To meet this cold war challenge, NASA engineers and scientists were given enormous technical latitude. Congress and the White House gave them a great deal of money.[12] They gave them a precise mission, generally viewed at the time as nearly impossible to accomplish, and a short period of time within which to do it. The freedom to exercise technical judgment, to take risks, and even to fail is enhanced in government under conditions such as these.

Project Apollo, the race to the Moon, was set up as a crash program. The strong sense of mission that accompanies a crash program provides government executives with their most reliable method for motivating agency employees to perform at very high levels. Crash programs help to clarify cultural norms as organizational beliefs are tested against pressing realities. Crash programs, however, always end. When they do, the agency that remains must confront the problem of maintaining its culture and its high level of performance under not so favorable conditions.

Changing environments alter governmental cultures. The NASA experience with flight testing illustrates how this is so. Between 1958 and 1965, NASA's budget steadily increased. At the same time, with space missions in a seemingly primitive stage, the cost of many rockets and spacecraft remained relatively low. Low costs and expanding budgets provided NASA with the opportunity to produce additional flight articles for testing. During Project Apollo, NASA and its contractors produced thirty-three command and service modules and twenty lunar landing modules at a per-unit production cost of approximately $55 million. Less than half of them carried astronauts into space. Twenty-five of them were used for ground and flight tests.[13] With more rockets or spacecraft on hand, it was easier for NASA managers to sustain a failure on a single test flight so long as no humans were on board.

By 1970, the political environment of the American space program had changed considerably. The contraction of NASA's budget and work force was well under way. At the same time, the real cost of most missions increased, even as agency officials sought mightily to reduce costs with programs like the Space Transportation System. Fewer dollars bought even fewer spacecraft. During the early years, between 1960 and 1972, NASA programmed $355,000 for the Orbiting Astronomical Observatory program, which bought four satellites.[14] The Ranger pro-

gram, which produced nine spacecraft, cost a total of $. ,000 in programmed funds between 1960 and 1966.[15] By contrast, NASA spent over $1.6 billion between 1978 and 1986 to design and build a single Hubble Space Telescope.[16] Contrary to the experience in business, where mass production and competition tend to reduce per-unit costs, the cost of NASA programs increased with time as their complexity grew, even adjusting for the value of the dollar.

Larger costs and smaller budgets reduced the opportunity for flight testing. NASA could not afford to request a few extra flight articles for testing when politicians choked on the cost of the main article. NASA officials turned more toward ground tests, where problems could be fixed before the main article flew. Aborted ground tests, moreover, engendered fewer political groans than flight test failures, especially for high-dollar items. Ground tests, however, could not duplicate flight conditions exactly, which increased the odds of failure in flight. Under the conditions of its new political environment, nonetheless, NASA officials had to learn to live with more ground tests.

The maturing of the American space program also affected NASA's commitment to in-house work. Between 1958 and 1965, as NASA built up the size of its work force, it assembled behind its doors many of the most knowledgeable people in the world in the technology of space flight. At the same time, because space flight was new, few competing centers of talent existed outside of NASA. As the Augustine committee later explained, "external space expertise hardly existed, and an aerospace industry had yet to be developed from airframe companies, their suppliers, and a nascent electronics industry."[17] NASA possessed the capability to do a great deal of its own work and to tightly monitor the work of contractors. NASA Administrator Keith Glennan, who favored a policy of extensive contracting out, nonetheless observed in 1960 that "most of our center directors believe that they can do the job faster, better and more cheaply than would be the case if they employ industry. In some instances, I think they are right."[18]

As NASA matured, so did the aerospace industry—in no small part due to the efforts of Glennan and James Webb, NASA's second administrator, to build it up. When bearers of the old cultural norms sought to restore NASA's in-house capacity with funds appropriated in the 1980s for new programs like the space station *Freedom*, they encountered a much more robust aerospace industry.[19] "The environment has changed," argued members of the Augustine Committee. "There is now a large and experienced space-academic community and

an industrial base whose skills are broad and deep." The Augustine Committee called upon NASA to adopt a more realistic approach toward in-house capability. "The Department of Defense sponsored National Security Space Program is almost twice the size of NASA's program," the committee observed, "but operates with only limited in-house laboratory support."[20]

In its early years, NASA could insulate itself from political pressures that might force cultural change. As it matured, that insulation disappeared. NASA became more accountable to Congress, the White House, and other groups with which it had to deal. This is a natural development in a government that requires multiple accountability among its public executives.[21]

The demands for increased accountability weakened the ability of agency employees to hold on to beliefs that did not conform to objective reality. Groups that can insulate themselves from outside pressure have a much better chance of maintaining such beliefs than those that are not so situated.[22] NASA employees knew that risk and failure were constant companions on space flights. Politicians and members of the general public, who had seen the frequency with which rockets blew up, seemed to know this too. NASA officials of the first generation used this knowledge to strengthen their belief in failure as a normal part of their job.

This belief; while widely held by NASA professional employees, was not objectively true. Politicians do not tolerate failure. Opponents of individual programs use catastrophes as devices for forcing a reconsideration of priorities. Even friends of programs use accidents as a means for strengthening political control. NASA seems to have insulated itself from this reality during its early years. The high priority granted the space program, respect for the assassinated president who had helped to launch it, and the luck of not having a really serious accident until 1967 all worked in NASA's behalf. NASA officials seemed genuinely surprised by the lack of tolerance for catastrophic failure when it actually occurred, following the fire in 1967 on Launch Pad 34 that took three astronauts' lives. The reaction to the *Challenger* explosion in 1986 was even more severe. The tolerance for really serious errors never seems to have been high—either outside NASA or in the upper levels of the NASA hierarchy—a fact adequately demonstrated by the failure of the first six Ranger probes.[23] It took many years for this to sink in, and it never displaced the underlying belief inside NASA during the first three decades of space flight that risk and failures could be excused as a normal consequence of agency responsibilities.

74-136 0 - 93 - 6

Administrative Growth

During the period that NASA's ability to resist demands for accountability wore thin, the number of demands increased. The administrative burden imposed on all federal agencies grew. Congressional staff tripled in size in the thirty years following the dawn of the space age. NASA executives who could once resolve problems by dealing with a few well-placed congressional leaders found themselves responding to multitudinous staff inquiries. The White House policy review process became more complicated. NASA executives who had earlier dealt with high-ranking White House officials, including the President and Vice-President, found themselves negotiating with White House minions whose approval was required before moving on. Civil service regulations proliferated. Procurement regulations metastasized.

These changes reduced NASA's technical discretion and accelerated the agency's slide toward a more bureaucratic mode of operations. Engineers and scientists who once had a relatively free hand in making what they viewed as technical decisions had to clear their work with congressional and presidential aides. The choice of lunar orbit rendezvous in 1962 as the means for taking Americans to the Moon was made wholly within NASA, even though the President's Science Advisor tried to get involved. By contrast, NASA engineers had to share the design of the space station *Freedom* with a variety of presidential aides, lawmakers, congressional staffers, and outside advisory groups for a seven-year period beginning in 1984. Not only were outsiders less willing to defer to NASA's technical judgment, there were more of them pressing their oversight claims on the agency.

NASA managed during its formative years to reduce the weight of bureaucracy by rotating people in and out of the agency. To build a bureaucracy, government officials must establish a career civil service: a group of lifetime employees whose material and social condition depends upon their willingness to carry out agency policy. Members of professions resist this. They do not like to tie their livelihood to a government job. Those who can move freely between jobs give public agencies a large measure of flexibility and freedom from bureaucratic control. To raise professional loyalties over bureaucratic allegience, however, these people need the freedom to move. Easy rotation in office thus provides one of the principal means for counteracting bureaucracy.[24] Within NASA, rotation in office also supported the assumption that the agency could (and would) recruit the very best people into the American space program. Through its open door policy, NASA

could bring them in from wherever they were, in part by promising them that they did not have to stay too long.

As NASA matured, Congress passed laws that made this harder to do—not just in NASA, but in all government agencies. In 1978 Congress passed the Ethics in Government Act, seeking to restrict abuses arising from the so-called revolving door. Specifically, the law prohibited a former government employee who took a job in the private sector, for a period of two years, from working on any government project in which he or she had been involved as a civil servant. In 1989 Congress amended the U.S. Code to permanently prohibit a former government employee from working on a government contract in which he or she had been previously involved, for the entire life of the contract.[25] This had a chilling effect on NASA's tradition of lateral movement among government, industry, and academia. It required scientists and engineers outside NASA to face the possibility that they might have to give up their professional interests for at least two years as a price for taking a tour of duty with the civilian space agency. Alternatively, they had to contemplate a lifetime commitment to a government job.

The Ethics in Government Act had a noble objective, namely a reduction in influence peddling by former government employees. Within the American space program, however, it had another distinct effect. Fewer employees rotated into NASA from outside the agency (see the appendix: working for industry). The act took its place alongside many pieces of administrative legislation that Congress passed during that period, one more general administrative regulation restricting the flexibility of NASA scientists and engineers to carry out the beliefs contained in their organizational culture.

Organizational Aging

While many forces impeding NASA's organizational culture arose outside the agency, others appeared from within. This is not to say, however, that NASA officials had any more control over them. If life cycle theorists are correct, then internal forces arise as a natural result of an agency growing old.

Life cycle theorists predict that management procedures will grow more elaborate and formalistic as an institution ages. They predict that the goals of the organization will shift toward those that maintain its survival, and that second-generation employees will lose their capacity to resist tendencies such as these. Faith in the ability to beat the system and avoid formal procedures was much reduced in the new NASA, as responses to the culture survey revealed (see the appendix: the NASA

bureaucracy). Management systems became more elaborate, but not because NASA employees wanted to make them so. In fact, NASA officials sought to reduce the burden of formal management control.

During Project Apollo, NASA executives developed strong management procedures that counterbalanced technical problem solving in the field. After Americans landed on the Moon, new executives established a more decentralized system. By moving program control out of Washington, they hoped to strengthen NASA's technical capability. Field officials fought for the new system because it gave them more control over their own future.

In this theory on the life cycle of bureaus, Anthony Downs suggests that organizational aging will occur as conservers gain the upper hand in the struggle for power with agency innovators.[26] In NASA, struggles for power occurred. The struggles, however, took place between different factions within the overall culture rather than different personalities. The resolution of the management issue had more to do with cultural politics than aging per se.

As a confederation of cultures, NASA contained people whose organizational philosophies often differed. Controversies arose during the first decade over issues such as all-up versus incremental testing, the proper role of contractors, and the amount of central control needed to direct field center work on expeditions like Project Apollo. Organizational politics helped to resolve such controversies. Different factions advanced their positions, which were usually resolved on the basis of individual skill and organizational goals. Although dominant positions emerged, losing factions still held to their points of view. The losing side could wait until changing conditions permitted reconsideration of the dominant mode. NASA did not function as a cultural melting pot so much as a political stew.[27]

Given the imperatives of the Gemini and Apollo space flight programs, the subculture of strong central control prevailed during the 1960s. As the Apollo program wound down, and NASA began the development of the space shuttle, the balance of power shifted. The Air Force group that promoted the doctrine of central control during the first generation was not as well situated to shape the management plan for the space shuttle, nor was the mandate for the shuttle as demanding as that for the race to the Moon. Factions from the field centers responsible for the development of the space shuttle prevailed in their effort to establish a much looser system of supervision. The looser system of supervision did not work as well. Rather than simplify the management of new programs like the space shuttle or the space station *Freedom*,

the new systems complicated it.[28] Organizational aging played a role in this transformation to the extent that factions could no longer rely solely upon the importance of the mission to resolve such disputes. Field officials had to worry about their survival and technical capability as well. During the Apollo era, NASA officials resolved problems like this by addressing the question, "Do we want to get to the Moon or not?"[29] That problem-solving orientation waned as NASA aged, and the imperatives of Project Apollo gave way to other concerns.

Life cycle theorists observe that government agencies become more concerned with survival as they mature and they predict that agencies will transform their methods of doing business as a result. NASA officials had to balance the importance of missions against the needs of embattled field centers to gain a fair share of new programs and protect themselves against outside control. The management of NASA changed as a result.

Culture and Performance

During its first decade, NASA exhibited many of the characteristics scholars associate with organizations that perform very well. It balanced technical discretion with central control. It developed a tradition of open communication and flexibility when faced with new challenges. It had a clear sense of mission and a strong organizational culture.

In government, it appears, characteristics such as these are hard to sustain. They do not persist for extended periods of time. The NASA experience suggests that three forces work against the maintenance of a high-performance culture in government: a volatile political environment, the long-term trend toward an increasing administrative burden in the government as a whole, and the natural processes of aging, fed by the inevitable expansion and contraction cycle that government bureaus go through. None of these turn out to be forces over which the managers of affected agencies can exerise much control.

These forces push high-performance government organizations toward the bureaucratic mold. Now, a bureaucracy can be a wonderful form of organization for carrying out some activities. Bureaucracies mail out checks on time, deliver supplies to troops in the field, and regulate commercial affairs. They do this by employing career civil servants who institute written rules through an official hierarchy that reduces the opportunity for favoritism or arbitrary decisions.[30]

The most successful science and technology programs of the twentieth century, however, have managed in some fashion to create a culture

that circumvents the bureaucratic mode. Government leaders do this, in general, by isolating the agency as much as possible from the forces that weaken the high-performance mode. They create crash programs that exist for only short periods of time. The Manhattan Project that developed the atom bomb and the National Radiation Laboratory project for the development of radar during World War II disappeared before bureaucratic imperatives could take hold. They create programs with a strong sense of mission, one of the principal ways for motivating employees to work hard and fight off forces that compromise organizational effectiveness.[31] During the race to the Moon, NASA possessed such a mission.

Designers of high-performance organizations place them well outside the bureaucratic mainstream, removed from official procedures and constrictions. Naval officers located the Polaris missile development program in a special projects office under the Secretary of the Navy, separated from the regular Navy bureaus.[32] The radar development project during World War II was run through the National Radiation Laboratory, a special organization set up at the Massachusetts Institute of Technology. The Synthesis Group, established in 1990 to suggest a strategy for returning to the Moon and moving on to Mars, concluded that a new National Program Office would be necessary to accomplish it. "The Space Exploration Initiative is so great in scope," the group ventured, "that it cannot be executed in a 'business as usual' manner and have any chance for success."[33]

None of these strategies provide such organizations with the capability to enter the governmental mainstream and sustain high-performance cultures for extended periods of time. Crash programs, specific missions, and special organizations are all by their nature methods for avoiding governmental routine. The NASA experience suggests that any attempt to retain a high-performance culture inside the governmental mainstream is doomed to fail.

The beliefs and assumptions underlying high-performance cultures may persist for some time, even after their original mission fades. As puzzling as this may seem, NASA engineers and scientists of the second generation retained many beliefs from the first generation even as they lost the ability to practice them. This may testify to the natural tendency of NASA engineers and scientists to approach their work as professionals rather than as bureaucrats. It may reflect an ability among first-generation officials to recruit second-generation professionals that fit the agency mold or to "break them in" in some unofficial way. By whatever method, NASA officials passed on their first-generation beliefs

to the second generation. They were unable, however, to pass on their ability to translate those beliefs into practice. A culture that permits such a gap between belief and practice cannot persist for long.

The early NASA culture developed out of institutions that had been practicing their beliefs for some period of time. The joining of values and practices created powerful traditions on which early NASA officials drew. "Look," said one of the first-generation engineers who had watched those traditions mature for more than a dozen years in a predecessor organization, "I don't know what makes this damn thing go that we've got here—that makes us so good and so great, and our capability to inspire people. But I'll tell you this, if we ever lose it I won't know how to tell you to regain it."[34] However short-lived they may be, successful cultures are not created overnight. NASA's early culture developed for many years before it blossomed during the first decade of space exploration. The period of transformation that followed took place over two decades. If NASA is to fashion a culture that is both successful and mature, it too will be years in developing.

Mr. CONYERS. Ms. Smith, welcome.

STATEMENT OF MARCIA S. SMITH, SPECIALIST, SCIENCE POLICY RESEARCH DIVISION, CONGRESSIONAL RESEARCH SERVICE, LIBRARY OF CONGRESS, ACCOMPANIED BY DAVID P. RADZANOWSKI, ANALYST

Ms. SMITH. Thank you. Happy to be here.

Mr. CONYERS. Do you have an additional point of view that you would like to add?

Ms. SMITH. Of the four congressional support agencies, none is better able to advise you on this committee on the management problems at NASA than GAO, which of course has testified to you already today. CRS was invited here to talk more generally about NASA and its successes and failures, and my written statement does address that. If you like, I can summarize my written statement or we can just proceed with questions.

[The prepared statement of Ms. Smith follows:]

Congressional Research Service • The Library of Congress • Washington, D.C. 20540-7000

TESTIMONY TO THE

COMMITTEE ON GOVERNMENT OPERATIONS

SUBCOMMITTEE ON LEGISLATION AND NATIONAL SECURITY

U.S. HOUSE OF REPRESENTATIVES

MARCIA S. SMITH
SPECIALIST IN SCIENCE AND TECHNOLOGY POLICY
SCIENCE POLICY RESEARCH DIVISION

ACCOMPANIED BY:

DAVID P. RADZANOWSKI
ANALYST IN AEROSPACE POLICY
SCIENCE POLICY RESEARCH DIVISION

OCTOBER 6, 1993

Mr. Chairman, members of the subcommittee, thank you for inviting CRS here today to testify about NASA and the space station program. With me is my colleague, Dave Radzanowski. We both would be happy to answer any questions you have about U.S. space activities, or the space programs of other countries in the world, including Russia. You have asked that this testimony focus on NASA's recent successes and failures, and the proposal for a Russian/American space station, so those will be the themes of my formal remarks. Although aeronautics is a highly important aspect of NASA's activities, I am not an aeronautics expert, so my testimony will be limited to the space program.

For better or worse, people tend to center their attention on things that don't work right, rather than on those that do. They remember failures much more than successes, at least in the short term. NASA has had its share of troubles lately, and so it is that the agency has fallen in public esteem. A September 1993 poll by CNN and USA Today found that 51 percent of those polled think NASA's funding should be reduced or terminated, a significant increase from similar polls conducted in previous years; 46 percent rate NASA's performance fair or poor. "What's wrong with NASA?" is a question asked more often than not.

Unquestionably, NASA is undergoing some dramatic stresses today. From "reinventing government" to constrained budgets, NASA is in the same situation as most Federal agencies. Change is always disruptive and threatening, and NASA is being asked to make fundamental changes in the way it works and how it explains its very existence.

Accustomed to public acceptance as a symbol of America's technological prowess and destiny to explore, NASA now is asked to justify its activities on more prosaic grounds. The Clinton Administration wants to make NASA more relevant to national needs, such as developing technologies that contribute to U.S. economic competitiveness. While always proud of the "spin-off" benefits of its programs, naming economic competitiveness as a primary goal must seem a disquieting development for NASA employees who joined the agency because of the romance of space travel and scientific quest for knowledge.

Times are changing and NASA must change with them. This is not a new set of circumstances for the space agency. It faced similar challenges following the first landing on the Moon in 1969. Having accomplished what it had been told to do -- win the "Moon Race" -- NASA found that the public turned its attention elsewhere. Instead of winning support for bold plans for future human space exploration programs, including trips to Mars, NASA could gain approval for only one new comparatively modest program -- the space shuttle.

In the early 1970s, as the final trips to the Moon occurred and NASA's first space station, Skylab, hosted three crews, development of the space shuttle began. The last Apollo flight, the 1975 Apollo-Soyuz Test Project, was a joint mission with the Soviets -- a symbol of detente between our two countries. (For those who contend that one of NASA's problems today is adjusting to the post

Cold War world, it can be argued that NASA proved capable of accommodating new political realities 18 years ago.)

The late 1970s were a relatively quiet period for NASA. Robotic spacecraft such as the Viking missions to Mars, the Voyager probes to Jupiter, and the Pioneer-Venus spacecraft sent back dazzling data, but there were no human spaceflight missions. Not until 1981 did American astronauts again venture into space aboard the first flight of the space shuttle. NASA's fortunes improved in the 1980s. It was not the shuttle itself, but the incoming Reagan Administration that, after a rocky start, gave new life to NASA. President Reagan's decision to initiate the space station program in 1984 and growing budgets, especially at the end of the decade, led NASA and space advocates to once again dream big.

The 1986 space shuttle *Challenger* tragedy temporarily shook confidence in NASA, but soon the public rallied behind the agency. Studies by experts outside the agency (the 1985-86 National Commission on Space) and within (the 1987 Ride report) postulated humans returning to the Moon by 2000 or 2005 and going on to Mars thereafter. Space science programs like Mission to Planet Earth and more planetary probes received attention and support. As the space shuttle returned to flight in September 1988, expectations rose. Despite looming Federal budget deficits and continuing difficulties in designing the space station (major redesigns were made in 1986, 1987 and 1989), overall support for the space program seemed high during the late 1980s. On the 20th anniversary of the first Apollo landing on the Moon (July 20, 1989), President Bush gave a major space policy address in which he called for the United States to begin a program that would return humans to the Moon and then go on to Mars in the 21st Century.

The tide began to turn away from NASA shortly thereafter. The 1990 budget agreement between Congress and the White House put additional pressure on domestic discretionary spending, such as NASA. Continuing problems with the space station program, coupled with the discovery that the main mirror on the Hubble Space Telescope was built improperly and the grounding of the space shuttle for five months because of hydrogen leaks, led many to ask the question that is still being asked today -- "what's wrong at NASA?" Another outside panel, headed by Norman Augustine of Martin Marietta, was formed to advise the President and NASA on the future of the space program. The 1990 Augustine committee report was followed by three reports in 1992 from Vice President Quayle's National Space Council -- the Fink report, the Aldridge report, and the Wilkening report -- all advising the government on what to do with the space program. NASA developed its own strategic plans during this period, and its many internal advisory groups made recommendations on specific fields of research. If nothing else, NASA has not lacked for advice.

Still, there is no national consensus on what NASA should do. The Clinton Administration's desire to make NASA more relevant to broader national needs such as economic competitiveness may ultimately become NASA's defining

purpose, but it has not taken hold yet. As during the early 1970s, NASA seems to lack for direction, a condition that certainly contributes to poor morale. NASA has weathered these storms in the past, and may well do so again.

The public seems less interested in morale problems at NASA than answers to why there seem to be so many failures. While nothing of the magnitude of the *Challenger* tragedy has occurred again, there have been other failures. The Hubble Space Telescope was found to be myopic, the main antenna on the Galileo probe enroute to Jupiter did not fully deploy (a less powerful antenna is still working, though), a new U.S. weather satellite program (GOES-NEXT) has experienced substantial cost overruns and schedule delays, space shuttles have been subjected to repeated schedule delays, the Mars Observer stopped communicating just before it was to enter Mars' orbit, and the NOAA-13 weather satellite (a different type from GOES-NEXT) failed days after launch. And since the media and the public rarely differentiate between NASA and Department of Defense space activities, any space failure is often perceived as NASA's, even though it may be unrelated to the agency. The Aug. 2 explosion of an Air Force Titan IV rocket off the coast of California was listed in many newspaper stories as part of the list of NASA's failures, even though it was an Air Force rocket carrying a payload for the intelligence community. So sometimes NASA gets blamed for space failures for which it bears no responsibility.

There have been many successes, too. Since the time of the *Challenger* tragedy, robotic spacecraft launched years ago continue to send back data to amaze the public and scientists alike. Voyager 2 sent back unprecedented views of Uranus and Neptune. Pioneer 10 told us when it reached the very edge of our solar system. A new probe was launched to Venus (Magellan) and produced detailed radar maps of our sister planet. Spacecraft in Earth orbit studied the origin of the universe (the Cosmic Background Explorer), and the nature of objects in the universe (Hubble Space Telescope, Compton Gamma Ray Observatory, Extreme Ultraviolet Explorer). Although the Hubble cannot fulfill its primary objective of studying faint, distant objects, it has provided useful data on near, bright objects. Other NASA satellites investigated the atmosphere (Upper Atmosphere Research Satellite) and the oceans (TOPEX/Poseidon). The space shuttle, which made its first post-*Challenger* flight almost exactly five years ago, since has been successfully launched on 32 missions. Many of these were devoted to scientific and technological experiments, from studying Earth and its atmosphere, to life sciences experiments, to developing new pharmaceuticals in the micro-gravity conditions in space. One shuttle crew rescued a communications satellite (Intelsat 6) that had been stranded when another type of rocket malfunctioned. While repeated launch scrubs exasperate even NASA's most loyal supporters, they recognize that the shuttle system is designed to minimize risk to the astronauts and that sometimes means last minute shut-downs because some system isn't operating within expected parameters. When a computer stops a launch seconds before liftoff, it is doing exactly what it was intended to do.

NASA certainly is not bereft of success stories and NASA supporters insist that spaceflight is a risky business and there always will be failures. They want the public, and Congress, to understand that this a price of being in the forefront of technology and exploration, and they consider it a price well worth paying.

The failures rarely demonstrate a common thread from a technical standpoint. Bad manufacturing and testing procedures for its main mirror created Hubble's myopia. A bad cable doomed NOAA-13. Faulty transistors may be to blame for the loss of Mars Observer. In most cases, NASA procures spacecraft from industry, rather than building them itself. Is there a problem with industry? The rocket and the two spacecraft that failed in August of this year (the Titan IV rocket, Mars Observer and NOAA-13) were all built by Martin Marietta. (The two satellites were built by General Electric's space division before it was acquired by Martin Marietta). Have workers become complacent? Is quality-control inadequate? Should NASA do more oversight of its contractors? The answer to all of these is probably yes. And a word of caution -- NASA is facing staff reductions along with constrained budgets, raising the question of whether it will have the people and technical skills needed to oversee its contractors.

But even under the best of circumstances, space will still be a risky business. The top levels of NASA management are advocating a "faster, cheaper, better" approach to many space programs. NASA could build several similar spacecraft for the same purpose if they cost less, and if one fails, the others may not. For each spacecraft that does fail, the cost would be much reduced compared to today's spacecraft. To reduce the cost, though, the mission may become riskier as levels of redundancy are eliminated. Whether the public and Congress will be less dismayed if another Mars probe is lost because it cost only $150 million instead of $511 million, or whether they will demand to know why NASA could not have added another redundant system that might have saved the mission, is a question awaiting answer.

An important aspect of mitigating risk is ensuring that programs are well defined and major changes avoided once development begins. This has been a problem for NASA for some time in several programs, but none more so than the space station program. Since it began in 1984, the space station has undergone five major redesigns (1986, 1987, 1989, 1991 and 1993). The most recent, ordered by President Clinton in February of this year, is the most dramatic yet. The old space station program, called *Freedom*, had reached the stage of detailed design and development (called Phase C/D) in December 1987. It passed through Critical Design Review (CDR) this summer, normally the final step before flight hardware is built. First element launch was scheduled for 1996, with the station ready for permanent occupancy in the year 2000.

Today, a less ambitious space station stands at Phase B (preliminary design) because President Clinton felt that *Freedom* would be too expensive not just to build ($30 billion), but to operate for its designed lifetime of 30 years (in excess of $2 billion a year). Cost growth in the program, revealed in January,

helped spur the President to order another redesign, telling NASA to design to cost rather than capabilities this time.

NASA has had a very difficult time creating a design that will fit within the Clinton Administration's budget envelope of $2.1 billion a year for the next five years, FY1994-1998. The new space station design, called Alpha, meets that cost goal, but by the end of the five years, no space station is in orbit. The first of 18 launches needed to assemble the station is scheduled for September 1998, the last quarter of FY1998. Completing the station will take another five years and $8.9 billion, for a total of $19.4 billion for development. This does not include the money already spent on the *Freedom* program ($9 billion for R&D; slightly more than $11 billion if other costs are included), the cost of shuttle launches or civil service salaries, or operating costs. The design lifetime has been reduced to 10 years, but NASA has not released estimates of operating costs yet.

In coming years, Congress undoubtedly will focus a great deal of attention on the costs associated with the space station program. But today, it is important to bear in mind that the design still has not been finalized. On September 7, NASA released information on the new Alpha design, but important technical decisions have yet to be made, such as the orbit in which the space station will fly and whether it will use an American spacecraft (called the Lockheed bus) or a Russian spacecraft (called the Salyut tug) for the critical functions of guidance, navigation and control (GN&C).

Even more significant is the fact that five days before the Alpha design was released, Vice President Gore and Russian Prime Minister Chernomyrdin announced that they had reached agreement to study the possibility of merging the Russian and American space station programs. It is important to point out here that the "American" space station is actually an international effort. Europe, Canada and Japan signed an agreement in 1988 to be our partners in this endeavor. They were involved in the process that led to the Alpha design, but apparently were excluded from the parallel discussions leading to the Gore/Chernomyrdin announcement.

So today there actually are three options on the table for building a space station: two Alpha versions and the "Russian/American" option announced by the White House. Little information is available about the Russian/American option; more is expected on Nov. 1. Conceptually, though, Alpha and the Russian/American option are quite different. Alpha is an "American" space station built on a partnership among the United States, Europe, Canada and Japan, for which some Russian hardware may be procured. According to initial information, the Russian/American space station can best be described as a Russian space station based on a partnership with the United States, to which the European, Canadian and Japanese may also be parties (though this is not yet certain.)

The Gore/Chernomyrdin agreement appears to have been based on foreign policy concerns rather than space policy. A primary motivation reportedly was to get the Russians to sign and abide by the Missile Technology Control Regime

(MTCR) which is designed to stem the proliferation of missile technology. In return, the Russians wanted increased space cooperation and $400 million ($100 million a year for four years). This money will come from NASA's budget, but not the space station budget, and will be spent on use of the existing Russian space station, *Mir*, development of a new technology for generating electricity in space (solar dynamic power), development of a common spacesuit, and other undefined purposes. It is hard to overlook the coincidence that the Russians claimed they would lose $400 million by cancelling a contract to sell India rocket engine technology and know-how, a contract the United States insisted be terminated if space cooperation was to move forward.

The benefits to Russia of the Gore/Chernomyrdin agreement are clear: they cannot afford a new space station on their own and Russian space advocates certainly want to continue their long history of having cosmonauts in orbit (*Mir* is the seventh successful Soviet/Russian space station); it bolsters an image of preeminence in space, since initial information shows that the first launches will be Russian and the station apparently will be controlled from Russia at least in the early years; and it brings them at least $400 million in hard currency which presumably will be used to save jobs in their aerospace industry.

What are the advantages to the United States? Unquestionably, the concept of a single "world" space station built cooperatively by former Cold War adversaries is very appealing to space enthusiasts who have long yearned for the opportunity to merge the space capabilities of the superpowers in the hope of accomplishing goals that neither could afford alone. NASA also asserts that there would be benefits in terms of cost and schedule of the space station program. The cost savings would result from accelerating the assembly schedule so that the station would be completed two years earlier than if it were built without the Russians, a savings of about $4 billion according to NASA.

Weighing against those benefits are some clear disadvantages. Chief among them is linkage between the space station and Russian adherence to the MTCR. An obvious question is what the United States will do if Russia violates the MTCR in the future. The precedent is not encouraging. The United States and China have had an on-again, off-again relationship on satellite export licenses because of MTCR concerns. This complicates satellite launch schedules, but would be devastating to a long term project such as a space station. Would the space station be subjected to the same vacillation as export licenses to China, or would the United States be inclined to ignore Russian MTCR violations in order to preserve the program? If Congress votes to terminate the space station next year or the year after, will Russia no longer feel bound by the MTCR? If so, does that tie Congress' hands on this program?

There are other risks associated with this proposal. First, it assumes continued political stability in Russia. As the events of recent days starkly demonstrate, that is not a given. Second, since the launch site Russia uses to support its space station is in a different country, Kazakhstan, the economic and political stability of that country are also of concern, along with continued good political relationships between Kazakhstan and Russia. Third, conditions at the

launch facility, called the Baikonur Cosmodrome, are deteriorating, raising concern about the health of the physical infrastructure needed to accomplish the program.

There are those who argue that the Russian/American proposal will win support from those who want to help Russia in its quest for economic stability and democracy, but it may lose just as much from those who favored the program because of jobs and American preeminence in human spaceflight endeavors, both of which could go to Russia under this proposal. Apparently moving away from the defense of space station on scientific grounds, these space advocates argue that finally the space station program has a clear rationale -- foreign policy. If the rationale for the space station program, like the Apollo program before it, is foreign policy, these advocates may find it a weak leg to stand on in the ever changing geopolitical climate we live in today.

Another question is what happens to the intergovernmental agreement the United States signed with Europe, Japan, and Canada to build the space station, and how our abrupt decision to bring in the Russians as a major participant in the program without consulting the partners factors into U.S. foreign policy towards those countries. Does working more closely with Russia mean relegating our traditional partners to secondary status?

For all the romantic allure of the proposal, it would be unwise to overlook the very real danger that merging the Russian and American space station programs could lead to the demise of both. Loading heavy political issues such as Russian stability and MTCR adherence onto the shoulders of a program that already has consumed 9 years and 9 billion U.S. tax dollars is not an especially inviting offer. What the space station program needs today is stability; foreign policy burdens do not advance that cause. If Russia violates the MTCR or other political fissures erupt, NASA could be back before Congress needing more money and more time to complete the program because it will have to be redesigned yet again.

The Gore/Chernomyrdin agreement appears to have merit from a foreign policy standpoint, but for the space station, the benefits are questionable.

Thank you, and Dave and I would be happy to answer any questions you have.

Congressional Research Service • The Library of Congress • Washington, D.C. 20540-7000

Memorandum October 4, 1993

TO : House Government Operations Subcommittee on
Legislation and National Security
Attention: Joe Cirincione

FROM : David P. Radzanowski DPR
Analyst in Aerospace Policy
Science Policy Research Division

SUBJECT : **Tables for October 6 Hearing on NASA**

Per our conversation, I am forwarding to you the following tables for your Committee's hearing October 6 on the National Aeronautics and Space Administration (NASA). The tables contain the following information:

Table 1	NASA's Current Major Space Research and Development Projects
Table 2	Cost of a Space Shuttle Flight (FY 1993)
Table 3	NASA Major Space Mission Failures
Table 4	NASA Major Space Missions with Significant Defects
Table 5	NASA Successful Major Space Missions

If you have any questions or require further assistance, please call me at 7-7059.

Table 1. National Aeronautics and Space Administration's (NASA's) Current Major Space Research and Development Projects

Major Project	Fiscal Year Initiated	Development Cost Estimate (in $millions)	Total Mission Cost Estimate* (in $millions)
Space Station			
Alpha	1993	19,400[c]	tbd
Freedom (FY1985-FY1993)	1985	11,200[d]	
Total		30,600	
Earth Obeerving System (EOS)	1991	8,002[e]	8,818[d]
Advanced Solid Rocket Motor (ASRM)	1989	3,126 - 3,326	3,700 - 3,900
Cassini	1990	1,450 - 1,550	2,979 - 3,379
Advanced X-Ray Astrophysics Facility (AXAF)	1989	1,770 - 1,970	2,590 - 2,835
National Aero-Space Plane (NASP)	1987	695[f]	tbd
Alternate Turbopump	1987	614[g]	tbd
Collaborative Solar Terrestrial Research (COSTR)[a]	1987	310 - 360	631 - 701
Advanced Communications Technology Satellite (ACTS)	1984	606	672
Ocean Topography Experiment (TOPEX)	1987	407	621 - 666
TDRS Replacement[b]	1987	360 - 370	503 - 523
Global Geospace Science (GGS)[a]	1988	360 - 400	562 - 632
Second TDRS Ground Terminal (STGT)	1988	530 - 575	556 - 601
Tropical Rainfall Measurement Mission (TRMM)	1991	260 - 290	413 - 463
X-Ray Timing Explorer (XTE)	1990	225 - 250	333 - 368
NASA Scatterometer (NSCAT)	1985	210 - 230	240 - 270

Source: NASA April 1993 Estimates.

* Total mission costs include development costs, launch and launch support, mission operations and data analysis, tracking and data support, and construction of facilities. Civil service costs are excluded.

tbd = To be determined.

a) U.S. contribution to the International Solar Terrestrial Physics (ISTP) program. COSTR is contributing instruments to European and Japanese satellites. GGS is contributing two U.S. satellites for launch in 1994.
b) Tracking and Data Relay Satellite (TDRS).
c) FY1994 through Permanent Human Capability (PHC), excluding civil service and shuttle launch costs.
d) Estimate as of June 1993.
e) EOS cost estimates through FY2000.
f) Estimated development costs through FY1998, excluding Department of Defense (DOD) development costs. NASP is a joint DOD/NASA program.
g) Estimated development costs through FY1998.

Prepared by CRS.

Table 2. Cost of a Space Shuttle Flight (FY1993)

Average Cost Per Flight	$413.5 million
Marginal Cost Per Flight	$ 44.4 million

Source: General Accounting Office. Space Transportation: The Content and Uses of Shuttle Cost Estimates. GAO/NSIAD-93-115, January 1993.

Average cost is the total cost to operate the space shuttle on a recurring and sustained basis for a given year divided by the number of flights planned for that year. This includes most of the shuttle operations budget, cost of civil servants, and cost of using the space communications network. This does not include total shuttle development costs, construction of 5 orbiters, facility construction, and shuttle upgrades which is approximately $32 billion from 1971 through 1993.

Marginal cost is the cost savings associated with deleting a single flight in any given year. This does not include fixed costs to launch the shuttle 8-9 times per year.

Prepared by CRS.

Table 3. NASA Major Space Mission Failures 1986 - Oct. 1, 1993

Mission	Year	Total Estimated Cost of Mission (in $millions)	Comments
Shuttle *Challenger*	1986	b	Launch failure; 7 astronauts perished; TDRS-B payload destroyed
GOES-G[a]	1986	214[c]	Launch failure
Mars Observer	Launch 1992 Failed 1993	855[d]	Lost contact with probe
NOAA-13[a]	1993	298[e]	Satellite lost all power

Source: NASA.

a) Weather satellites built and launched by NASA for the National Oceanic and Atmospheric Administration (NOAA). NOAA funds the building and launching of the satellites and operates the satellites on orbit.
b) Destroyed Tracking and Data Relay Satellite (TDRS) that was part of project to build and launch 6 TDRSs at an estimated total of $2,156 million. See Table 2 for breakdown of cost of shuttle missions.
c) Total estimated cost of $214 million is for the building and launching of 2 GOES satellites.
d) A total of $855 million was to have been spent on Mars Observer by the end of FY1993. If the program had continued, total estimated cost was $944-964 million not including $15 million in international funding.
e) Total estimated cost of $298 million is for the building and launching of 3 NOAA satellites.

Prepared by CRS.

Table 4. NASA Major Space Missions with Significant Defects 1986 - Oct. 1, 1993

Mission	Year Launched	Total Estimated Cost of Mission (in $millions)	Comments
Hubble Space Telescope	1990	1,682[a]	Improperly manufactured primary mirror leads to blurred images; also has unexpected vibration of solar panels and gyroscope failures; shuttle mission scheduled in December 1993 to make corrections to the flaw, replace solar panels and failed gyroscopes among other repairs.[b]
Galileo	1989	1,639	Planetary probe mission to Jupiter due to arrive in 1995; main antenna did not fully deploy; a less capable antenna is working.

Source: NASA.

a) Total estimated cost does not include mission operations and data analysis costs of $200-250 million per year. Hubble is expected to operate 15 years.
b) December shuttle servicing mission is estimated to cost $251 million, $86 million of which is attributed to the mirror flaw. This cost estimate does not include the cost of the shuttle flight since flight was planned before the flaw was discovered.

Prepared by CRS.

Table 5. NASA Successful Major Space Missions 1986 - Oct. 1, 1993

Mission	Total Estimated Cost of Mission (in $millions)	Comments
1986		
1 Shuttle launch	b	Deployed SATCOM commercial communications satellite.
NOAA-G	218[c]	For NOAA; retired after operating successfully.
1987		
GOES-H[a]	214[d]	For NOAA; still operating.
Palapa	Not Available	Commercial communications satellite; launched by NASA for Indonesia.
1988		
2 Shuttle launches	b	Deployed TDRS-3 and a DOD mission.
TDRS-3	e	Still operating as back-up.
NOAA-H	f	For NOAA; still operating.

Table 5. NASA Successful Major Space Missions 1986 - Oct. 1, 1993

Mission	Total Estimated Cost of Mission (in $millions)	Comments
1989		
5 Shuttle launches	b	Deployed TDRS-4, Magellan, and Galileo; and 2 DOD missions.
TDRS-4	e	Still operating.
Magellan	856	Successfully mapped Venus and is still operating.
Cosmic Background Explorer	210	Still operating.
Galileo	1,639	Planetary probe mission to Jupiter; main antenna did not fully deploy; a less capable antenna is working.
1990		
6 Shuttle launches	b	3 DOD missions; deployed Hubble and Ulysses spacecraft; and ASTRO-1 shuttle attached payload.
Roentgen Sat. (ROSAT)	22	Joint program with Germany and U.K; German satellite with NASA instrument.
Ulysses	460	Joint program with European Space Agency (ESA); on its way to a solar orbit.
Hubble Space Telescope	1,682	Despite flaw in primary mirror and other component failures, Hubble is still highly capable of imaging near and bright objects.
Combined Release and Radiation Effects Satellite	15	Joint mission with DOD.
1991		
6 Shuttle launches	b	2 DOD missions; deployed Compton GRO, TDRS-5, and UARS; and Spacelab Life Sciences-1.
NOAA-12[a]	298[f]	For NOAA; still operating.
Compton Gamma Ray Observatory (GRO)	677	Still operating on orbit.
TDRS-5	e	Still operating on orbit.
Upper Atmosphere Research Satellite (UARS)	790	Several instruments still operating.
Solar-A	27	Launched by Japan; joint program with Japan.
Total Ozone Mapping Spectrometer (TOMS) Instruments	32	Instruments launched by former Soviet Union on the Soviet Meteor-3 satellite.

Table 5. NASA Successful Major Space Missions 1986 - Oct. 1, 1993

Mission	Total Estimated Cost of Mission (in $millions)	Comments
1992		
8 Shuttle launches	b	1 DOD mission; deployed Eureca for ESA and Lageos; International Microgravity Laboratory-1 (IML-1); Atmospheric Laboratory for Applications and Sciences-1 (ATLAS-1); on-orbit repair of Intelsat VI; U.S. Microgravity Laboratory-1 (USML-1); and Spacelab-J (Japan).
Extreme Ultraviolet Explorer (EUVE)	322	Still operating.
SAMPEX	78	Still operating.
Geotail	g	Satellite built by and launched for Japan; part of U.S. COSTR.
Ocean Topography Experiment (TOPEX)	520	Project with France; launched on European Ariane launch vehicle.
Lageos	40	Italian satellite launched by NASA.
1993		
5 Shuttle launches	b	Deployed TDRS-6 and ACTS; Spacelab D-2 (Germany); ATLAS-2; and retrieved Eureca for ESA.
TDRS-6	e	Still operating.
Advanced Communications Technology Satellite (ACTS)	656	Successfully deployed; undergoing check-out.
Astro-D	11	Launched by Japan; joint program with Japan.

Source: NASA.

a) Weather satellites built and launched by NASA for the National Oceanic and Atmospheric Administration (NOAA). NOAA funds the building and launching of the satellites and operates the satellites on orbit.
b) See Table 2 for breakdown of cost of shuttle missions. Cost of shuttle mission does not include cost of the payload.
c) Total estimated cost of $218 million is for building and launching of 5 NOAA satellites.
d) Total estimated cost of $214 million is for building and launching of 2 GOES satellites.
e) Total estimated cost of $2,156 million is for building and launching of 6 TDRS satellites.
f) Total estimated cost of $298 million is for building and launching of 3 NOAA satellites.
g) Part of the Collaborative Solar Terrestrial Research (COSTR) program which is estimated to cost NASA $630-700 million.

Prepared by CRS.

Mr. CONYERS. Well, do you agree with Mr. Pike and Dr. McCurdy as fellow witnesses?

Ms. SMITH. As I said, in terms of the specific areas of the management of NASA that Mr. Pike and Mr. McCurdy have already discussed, I think that GAO is better able to help you with those issues.

Mr. CONYERS. What are you able to help us with some?

Ms. SMITH. I can discuss with you, as my written statement has, a general discussion of NASA and its successes and failures over the years, how the agency has gotten to where it is today, and why it is that it seems that people are so concerned about what is wrong at NASA. What I tried to point out in my written statement is that although it is the failures that get all of the attention, and in the short term, at least, that is what people remember, there are an awful lot of successes at NASA as well. There is no question, especially based on the testimony you have heard today, that there are a lot of deficiencies at NASA in terms of their procurement activities and their management activities, but in the long run if you look at the overall history of NASA over the years since it was created in 1958, despite those problems, it has ultimately provided this country with many more successes than failures.

Mr. CONYERS. Well, I concede that, Ms. Smith. Would your advice to Government Operations be relax or cool it or as the kids say, chill, why don't you chill out, and look at this thing in the historical context and once you spread it out there, you know, take two aspirins and wake up in the morning and you say, well, they are really not that bad.

Ms. SMITH. Well, certainly from the testimony that you have heard this morning, there are very definite problems at NASA, and I think that this committee has a very valuable role to serve in helping NASA achieve the outcomes that NASA says it wants to achieve.

Mr. CONYERS. Mr. Pike, any closing thoughts?

Mr. PIKE. Well, I think that the fundamental problem facing the space program today is understanding why these problems are occurring, and I think that the real challenge for NASA is going to be to develop the institutional mechanisms to answer that. NASA was basically set up to compete with the Soviet Union during the cold war as part of the space race. Now that the cold war is over, NASA's main institutional mission is going to be to cooperate with the Russian space program, and I think that unfortunately NASA designed to compete with the Soviet Union is not institutionally equipped to cooperate with the Russians. It is going to require major institutional innovations at NASA for them to be able to do that, and it is not apparent to me that they understand the full depth of the change in their culture, practice, and organization that is going to be required.

Mr. CONYERS. Are the Russians constitutionally put together to cooperate with us?

Mr. PIKE. Well, that is clearly going to be one of the major challenges for NASA to figure that out. Whatever difficulty NASA has had in assessing the strengths and weaknesses of its own field centers or its own contractors, I think are going to pale in comparison with understanding the strengths, weaknesses and capabilities of

our new Russian collaborators. That is clearly going to require institutional capabilities that NASA simply does not have on hand right now. It is going to require personnel and talents far beyond what they have. I think that is a major challenge facing NASA today.

Mr. CONYERS. Well, you make some of us wonder whether we should even—whether we shouldn't question more closely the collaboration.

Mr. PIKE. I think that it is absolutely essential in this post-cold war environment that NASA, as with every other major government agency, understand what its role is going to be to contribute into developing a post-cold war order. I think that the space race was clearly a defining element of the cold war, and I think that cooperation in space with the Russians is going to be, as I think that Bill Clinton and Al Gore and Dan Goldin have recognized, a defining element in defining the new partnership between America and Russia. This is, after all, an extremely visible expression of our national identity and their national identity, and by joining together in this very visible way I think that it can be the flagship for the collaboration that we are going to have to engage in in future decades. NASA, I think, has really found a place for itself in the post-cold war order in a way that it has not had since perhaps the early 1960's.

Mr. CONYERS. Oh, yeah? Tell me about it. What is this?

Mr. PIKE. I think if you look at the national security challenges facing the United States today, let's go down the list, we are concerned about stabilization of democracy in Russia. Demonstrating that we are committed to continuing long-term cooperation with the Russians in space I think demonstrates our optimism that democratization and reform is going to take place there. Engaging the Russian aerospace complex which, after all, has been part of Russian society which potentially has the most to lose from the end of the cold war is going to give them something to do besides plotting to get rid of Boris Yeltsin and it is certainly going to give them something to do besides hopping on an airplane and flying off to North Korea where they would be contributing to ballistic missile proliferation.

By solving all of these problems, stabilizing Russia and dealing with missile proliferation, I think that that is going to free up additional resources for us to deal with the other problems America is facing today, so our space program I think in the way that Bill Clinton, Al Gore, and Dan Goldin have reconceptualized it in the last several months has gone from being largely irrelevant to the concerns of America to being at the absolute centerpiece of where American national policy is going. I think that is good for America and good for NASA if NASA is organized to be able to respond to that challenge, and at this point they are not.

Mr. CONYERS. OK. I didn't understand you to say that NASA ought to copy Star Wars Program management because Star Wars is one of the top suspect organizations on our list, having blown about $34 billion. You don't want them to be a model that NASA would emulate?

Mr. PIKE. I would say precisely to the contrary. I think there are a number of management practices and institutions at the Defense

Department that this committee would do well to try to understand whether NASA should emulate, but over the last several years there has been a lot of talk about NASA being an aging, incompetent institution, the strategic defense initiative organization being a model perhaps for NASA to follow, but if I look at SDI's performance over the last 3 years in 1990, 1991, and 1992 something like half of their flight experiments either failed completely or had serious problems in performance. If NASA had been turning anything in remotely resembling Star Wars performance over the last several years, I am sure that there would be broad agreement that the civil space program should be completely shut down, so I would say SDI is probably the last place that we should be looking for reorganizing NASA.

Mr. CONYERS. I am greatly relieved.

Dr. McCurdy, any final observations?

Dr. MCCURDY. I would just like to comment on the international aspects of this. You might want to ask Marcia Smith about this. She is quite well informed about it. NASA has difficulty managing its own field centers. If it has difficulty from Washington through strong program offices managing its own field centers, imagine the management problems it will have when it attempts to manage Russian field centers and field centers that are part of the Russian space program that are not in Russia. The problems, the management problems will be tremendous. If there was ever an argument for a separate oversight committee, that is probably the best argument of all. This is going to——

Mr. CONYERS. Thank you.

Dr. MCCURDY [continuing]. Be the first great test of our capability to work internationally, and the space station is one of the models for this. If we can learn to work internationally and manage international programs that are highly complex technically, then that could lay the ground work for all kinds of advances in international relations that we heretofore have not been able to accomplish.

Mr. CONYERS. Ms. Smith.

Ms. SMITH. NASA, of course, has been involved in international space programs almost since its founding. The space station program is already very broadly international. It is a partnership among the United States, Europe, Canada, and Japan, and in this case it is not so much that NASA is trying to manage field centers abroad because those countries bring their own hardware to the table, and so those countries manage their own programs. They all meet up in orbit, so to speak. I think that the space station program is already an example of the international management of a large space program.

I do have a different perspective on the issue of joining with the Russians than Mr. Pike does. I think that the prospect of marrying the American space program and the Russian space program is very appealing emotionally, and a lot of space enthusiasts over the decades have long yearned for this time when finally we could break down the cold war barriers and get together the capabilities of these two very powerful countries. I think that there are a lot of opportunities in space for broader cooperation between the United States and the former Soviet Union.

The particular program that has been chosen as the hallmark of this, the space station, however, was probably not the best choice. This program already has been in progress for 9 years. The taxpayers have already spent $11 billion on it. It has been redesigned five times already, and adding foreign policy burdens to this program will not necessarily lead to its successful completion.

There are a number of political problems that could complicate the program. First and foremost is stability in Russia. As we have seen in the past several days, that is not a given. It appears as though one of the major reasons for signing the agreement on the joint space station was to induce the Russians to abide by the missile technology control regime, to prevent the proliferation of ballistic missile technology. That therefore raises the question of what would happen if Russia were to violate the MTCR in the future. The launch site that the Russians would use to support the program is in a different country, Kazakhstan, so you also have to worry about the political and economic stability of Kazakhstan in order to complete the program. And there are concerns about the physical infrastructure at that launch facility called Baikonur, so I think there are a lot of negatives associated with trying to join our space station programs. This is not to dismiss the possibility of other space cooperation, and if we were beginning a space station program today from scratch, joining with the Russians would be a natural fit. They have a space station in orbit today. It is their seventh successful space station since 1971. But because the space station program that NASA is funding already has been in progress for so long and has had such a troubled history, I don't think this is a positive development for it.

Mr. CONYERS. I can't express to you all how grateful we are for your testimony. We thank you all very much. You all would have testified the same had you been administered the oath, is that not correct?

Dr. MCCURDY. Yes. [All three witnesses said yes.]

Mr. CONYERS. All right. Thank you very much. The subcommittee stands adjourned.

[Whereupon, at 12:03 p.m., the subcommittee adjourned, to reconvene subject to the call of the Chair.]

APPENDIX

MATERIAL SUBMITTED FOR THE HEARING RECORD

GAO RESPONSES TO QUESTONS SUBMITTED BY MINORITY STAFF

1. GAO reported to Congress last year that NASA's internal controls and financial management systems did not provide accurate and reliable financial information for effective management of the agency. You specifically identified oversight of the substantial amount of assets and funds under the control of its contractors as an area in need of corrective action. What can you report that NASA has done to solve some of the problems identified in the October 1992 report?

Since our report was issued, NASA has initiated a considerable number of actions to address the serious weaknesses we found in its controls over contractor-held property and unreliable reporting of contractors' costs. In the cost reporting area, NASA has implemented or is in the process of implementing new procedures that are intended to ensure that procurement solicitations include cost reporting requirements, to justify the use and determine the accuracy of accruals related to contractors' estimated costs, to improve the timeliness of contractors' cost reports, and to determine the timing and results of DCAA's reviews of NASA contractors' cost estimating systems. In the property area, NASA is monitoring the accuracy and timeliness of its contractors' property reports, increasing its oversight of property disposal, and reviewing its internal control procedures for managing property. NASA will also need to making additional significant changes based on our September 9, 1993, report, NASA PROPERTY: Improving Management of Government Equipment Provided to Contractors, GAO/NSIAD-93-191, which describes further serious weaknesses in how NASA provides, controls, and reports contractor-held property.

2. In your December 1992 report, you indicated that "the nature, scope and variety of efforts underway to improve contract management and related areas . . . illustrate the commitment by NASA management to effectively resolving the problems in these areas." You also added that, "Although this commitment is promising, these problems will require time and sustained effort to correct." In your opinion, has sufficient time elapsed to expect NASA to have completed the reforms identified by GAO in December 1992? If not, how much time will be needed for this process? Do you still believe NASA is committed to making these changes? Is NASA doing everything it should in reforming its contract management? What is NASA not doing that it should be? How would you characterize NASA's leadership efforts in the past year or so to reform NASA's management practices?

Sufficient time has not elapsed for every reform to be in place, but enough time has elapsed to expect substantial progress in developing and implementing them. We periodically track NASA's progress in implementing changes in response to numerous recommendations we have made over the past few years for improving

contract management. Many of those recommended changes have been made or are being implemented. Also, we are currently reviewing NASA's efforts to plan and implement a variety of contract management improvements it has identified on its own initiative. This review was requested by the House Committee on Government Operations and we expect to report the results of our work by the Spring 1994.

It is difficult to say when the implementation of all the needed changes identified to date may be completed. To a certain extent, it depends on when the need for the change was first recognized. For example, our recently issued report on the weaknesses in NASA's management of government property contained numerous recommendations for changing NASA's policies, procedures, and practices related to providing, controlling, and reporting such property. Implementation of some of the recommendations may not be completed for another year or more.

Given NASA's own improvement initiatives and its general acceptance of our recommendations, we believe the agency remains receptive to considering and making appropriate contract management improvements. We are not aware of any serious contract management weaknesses that are not being addressed. However, we continue to do work related to contract management, and additional improvement opportunities could be identified. If so, we would fully expect NASA to adequately consider them.

3. GAO has identified a lack of strategic planning by NASA as one of the root causes for NASA's historic problems with budget planning. How do you respond to claims that effective strategic planning is difficult when the executive branch hesitates or refuses to commit beyond one year and Congress authorizes funds for only one year? Is this a valid claim? If so, what action would you recommend to address this dilemma?

The concern about the short-term nature of commitments has some validity that, in fact, serves to heighten the importance of effective strategic planning, not lessen it. Specifically, effective strategic planning would help NASA reclaim control over the pace and content of its programs. A good strategic plan could help foster essential agreement between NASA, the administration, and the congressional authorizations and appropriations committees on overall program content and pace, and on the general budget level for the agency. While future authorizations and appropriations levels cannot be set in advance, a mechanism for focusing key players' attention on the future and eliciting from that process at least a general agreement about likely future budgets, certainly provides a better basis for managing a broad variety of long-term projects such as those commonly found throughout NASA.

4. Do you still agree with the statement in your December 1992 report that " . . . NASA's culture has been characterized by a "can-do" attitude and a strong esprit-de-corps [which] has been a major factor contributing to the agency's hard-earned reputation for technical brilliance and monumental achievements".

Yes, especially in the context that the "flip side" of that same culture creates barriers to change, principally in the form of failing to recognize that changing circumstances justify re-thinking how NASA has historically done business. NASA's greatest management challenge is to inculcate agency personnel with the new operating approach without destroying the positive aspects of its historic culture.

BOSTON PUBLIC LIBRARY
3 9999 05982 423 3

ISBN 0-16-043292-8